EVALUATION AND TREATMENT OF CHRONIC LOWER EXTREMITY MUSCULOSKELETAL CONDITIONS FROM A REGIONAL INTERDEPENDENCE PERSPECTIVE: A DISSERTATION IN CLINICAL PRACTICE IMPROVEMENT

A Dissertation
Presented in Partial Fulfillment of the Requirements for the
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by

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AUTHORIZATION TO SUBMIT DISSERTATION

This dissertation of Robert Bonser, submitted for the degree of Doctor of Athletic Training with a Major in Athletic Training and titled “EVALUATION AND TREATMENT OF CHRONIC LOWER EXTREMITY MUSCULOSKELETAL CONDITIONS FROM A REGIONAL INTERDEPENDENCE PERSPECTIVE: A DISSERTATION IN CLINICAL PRACTICE IMPROVEMENT,” has been reviewed in final form. Permission, as indicated by the signatures and dates given below, is now granted to submit final copies to the College of Graduate Studies for approval.

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ABSTRACT

A dissertation of clinical practice improvement (DoCPI) is a compilation of the DAT student's scholarly works, philosophies, patient outcomes, and original research, all of which highlights the personal, professional, and clinical growth of the advanced practitioner. This DoCPI begins with a narrative reflection of clinical practice and development of a Plan of Advanced Practice (PoAP). The PoAP involves reflecting on my individualized strengths and weaknesses, developing focus areas, and outlining a plan for achieving growth in each focus area. The DoCPI also contains a summary and assessment of patient outcomes for the purpose of highlighting my growth in clinical decision-making and implementation of Evidence-Based Practice (EBP). Furthermore, my knowledge of chronic lower extremity conditions, and ability to review, assess, and critique the literature is demonstrated in the Critically Appraised Topics (CATs) on the topic of hamstring tightness. Lastly, the DoCPI will include a manuscript focused on the evaluation and treatment of hamstring tightness from a RI approach. Therefore, the DoCPI is evidence of my personal, scholarly, and clinical growth in chosen areas of advanced practice through a compilation of written works.

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DEDICATION

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To Christ, for the earthly gifts that were given to me for the purpose of glorifying him and serving others. I am a sinner saved by His grace, and am thankful and joyful for His sacrifice on my behalf. Soli Deo Gloria

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CHAPTER 1

NARRATIVE SUMMARY

The University of Idaho designed the Doctor of Athletic Training (DAT), a terminal degree in Athletic Training, in order to develop advanced practitioners who specialize in clinical practice and clinical research. Students in the DAT program pursue a Professional Practice Doctorate (PPD). Unlike a PhD., which focuses on theoretical knowledge a Professional Practice Doctorate (PPD) focuses largely on improving clinical practice through collaborative learning, action research, and a final dissertation or capstone project (Willis, Inman, & Valenti, 2010). The dissertation required for the DAT program is a Dissertation of Clinical Practice Improvement (DoCPI). The DoCPI is a compilation of the DAT student's scholarly works, philosophies, patient outcomes, and original research, all of which highlights the personal, professional, and clinical growth of the advanced practitioner (Nasypany & Seegmiller, 2012).

Advanced practitioners are leaders in the profession of athletic training who practice and teach techniques for improving patient care and who develop areas of advanced practice within the profession. A statement made in 2012 by the National Athletic Trainer's Association (NATA) and Board of Certification (BOC) calls for clinical research that focuses largely on evidence-based practice (EBP) and on the collection of patient-rated outcome measures (PROMs) (Brown, 2012). Therefore, as ambassadors of future growth in patient care, advanced practitioners must be experts within the profession of athletic training. From my perspective, advanced practitioners must be efficient in the following areas: EBP, practice-based evidence (PBE), PROM, action research (AR), self-reflection, the critical analysis of literature, advanced practice areas, multi-site research, data analysis, and the dissemination of scholarship.

Evidence-based practice is defined as, "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients" (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). A model developed by Dr. Robert Hayward, called the "evidence-based information cycle," breaks down the process of practicing EBP into five steps: assess, ask, acquire, appraise, and apply (Hurley, Denegar, & Hertel, 2010). The EBP approach is important for delivering patient-centered care, creating inter-professional teams, practicing evidence-based medicine, and improving the quality of patient care (Welch et al., 2014).

Although EBP is being brought to the forefront of the athletic training (AT) profession (Steves & Hootman, 2004), clinicians have identified many barriers to implementing EBP into their daily habits (Manspeaker & Van Lunen, 2011). These barriers include a lack of time, knowledge, resources, skills, and employer support (Manspeaker & Van Lunen, 2011; Welch et al., 2014). It has been suggested that clinicians use rehabilitation techniques to solve local problems and generate PBE, which adds to existing literature in a more clinically relevant way (Green, 2008). Learning the concepts of EBP and PBE are essential to the growth of an advanced AT practitioner. Rather than simply possessing an understanding of a specific content-knowledge area—which becomes outdated quickly as new techniques develop—an advanced practitioner must understand and practice the skills necessary to sustain a continual pattern of growth within his or her profession. Both EBP and PBE must be understood and demonstrated so that the advanced practitioner may continue in his or her pattern of knowledge and growth for years to come.

Chapter 2 of this DoCPI contains my Plan of Advanced Practice (PoAP), which highlights my goals for continual growth as an advanced practitioner who uses knowledge and application of EBP and PBE. I highlight my journey in the profession for the purpose of reflecting on my personal growth as an advanced practitioner in AT and to illustrate how I have arrived at my current level of knowledge. I also expound on my chosen areas of advanced practice within the AT profession. Additionally, I utilized the PoAPs structure to critically assess my strengths and weaknesses in the profession and to develop a specific and measurable 5- to 10-year plan for growth in each area. Over the past two years, while collecting PROMS, performing EBP, and generating PBE, I have adjusted my PoAP to reflect my knowledge and growth. Therefore, the PoAP is evidence of my growth, self-reflection, and plan to continue using EBP, PBE, and PROMS as a practitioner in my chosen areas of advanced practice.

In addition to understanding and applying the concepts of EBP and PBE, an advanced practitioner must become adept at using and applying the concepts of action research (AR) and critical reflection on PROMS. *Action research* is defined as the cyclical process of observation, reflection, planning, and implementation in approaching a clinical problem (Koshy, Koshy, & Waterman, 2010). One of the best ways to generate evidence from practice and improve patient care is to track specific local problems through PROMs. Patient-reported outcome measures are important for obtaining feedback on treatment efficacy, improving patient-centered care, and allowing the patient to express how they feel (Valier, Jennings, Parsons, & Vela, 2014; Vela & Denegar, 2010). Reflection on PROMs is perhaps the most integral component of the action research cycle. A clinician must reflect at each stage of research in order to appraise the effectiveness of his or her interventions and set future goals. Reflection can be achieved through journaling, obtaining peer feedback, and systematic compilation and analysis of patient outcomes related to a specific problem or injury (Koshy et al., 2010).

Chapter 3 of my DoCPI highlights my competence in the knowledge and application of EBP, PBE, PROMS, AR and reflection. I demonstrate the EBP and AR process by identifying several key problems in my clinical practice (i.e., medial tibial stress syndrome, patellar tendinitis, and low back pain) and then making a plan for treatment and the collection of patient-outcomes. I then use my outcomes and journals to reflect on my practice and treatments and to make new goals according to what was or was not successful. One lesson I learned within the first month of practice was that it is not viable to collect detailed outcomes on every patient due to the difficulty of organizing when each patient needs to take the PROMs. Therefore, I had to pick one or two conditions at a time to analyze so that I could become better at treating patients individually.

I also incorporate journal entries about my patient care, which demonstrates the practice of reflection. At first, reflection did not come easily for me. I began haphazardly, by not giving many details and not thinking critically enough about my clinical decision-making process. However, as I progressed with my patient outcomes collection and analysis, I began to organize and reflect on my practice, clinical decision-making, and patient encounters in a more meaningful way, which has allowed me to address local problems more effectively. This is evidenced in my journal entries and in my patient-care narrative.

Other skills an advanced practitioner must possess include the ability to critically appraise literature and to identify an area or areas of advanced practice. The ability to appraise literature is necessary for any advanced practitioner who wishes to learn from others' mistakes and successes within clinical medicine (Hankemeier et al., 2013; Horsley et al., 2011). By critically analyzing journal articles, the advanced practitioner has the opportunity to adopt new practices into his or her own patient care and forego or re-test methods that may have been questionable. The selection of an area or areas of advanced practice is a recent development in AT and is perceived by the BOC as being critical if an advanced practitioner is to improve quality of patient care and enhance patient quality of life (Brown, 2012). Advanced practice areas are not constrained to a specific area of the body, but may encompass a focus in PROMS implementation, tendinopathy, or other specific pathologies that fall under the domain of AT. Developing areas of advanced practice will help athletic trainers establish their careers, become leading experts in the profession, and enhance and improve patient care (Brown, 2012).

Chapter 4 of my DoCPI is comprised of two Critically Appraised Topic (CAT) manuscripts that highlight my chosen area of advanced practice within the profession and elucidate my ability to critically appraise peer-reviewed articles. My primary area of advanced practice is lower extremity chronic injuries. I chose to focus on lower extremity chronic injuries because of my personal experience with injuries in this category, and also because I have worked with a patient population that frequently suffers from these injuries. One of the conditions that falls into this category is apparent hamstring tightness in an active population. In preparing my research on this topic and to broaden my base of knowledge in this area, I conducted a thorough literature search with peers. As we researched the various rationales for using alternative techniques for increasing knee extension range-of-motion (ROM), we found several promising studies on increasing hamstring ROM using Neurodynamic Sliders (NDS) as opposed to stretching techniques. Research in this specific area helped me to continue to widen my base of knowledge within my area of advanced practice and develop my skills for critically appraising literature. The CATs are evidence of my knowledge in my chosen area of advanced practice, in statistics, and of current research methods. They also showcase my ability to critically appraise literature using the Physiotherapy Evidence Database Quality Scale (PeDRO).

Finally, advanced practitioners must disseminate scholarly works, analyze data, and collaborate with other professionals. The production of scholarly works is evidence of *scholarship,* which has been defined as “the process of advancing knowledge” by gaining and disseminating information related to a specific area of study (Knight & Ingersoll, 1998). Scholarship is important to AT, because, ultimately, it will improve patient care and increase recognition of the value of athletic trainers from the general population and other health professions (Knight & Ingersoll, 1998). Scholarship is not obtained through the possession of an advanced degree; rather, it is the quality of curiosity and generosity that is instilled in a person which drives the perpetual desire to research and share information to benefit the greater population. Scholarship, therefore, necessarily involves the dissemination of research to the larger population—a process that most often involves collaborating with a group of other healthcare professionals in studying, presenting, organizing, and writing manuscripts. Weinberger et al. (2001) highlighted numerous benefits to performing multi-site, collaborative research with other professionals, including enhanced external validity, greater statistical power, and rapid subject recruitment (Weinberger et al., 2001). Although there are, potentially, numerous barriers to achieving effective multi-site research—including difficulty in group organization and low internal validity—multi-site research seems to be an effective means of producing high quality research studies (Fuller-Rowell, 2009). Regardless of whether the research performed is “multi-site” research, collaboration between professionals is essential to the growth of a practitioner(Carr & Drummond, 2002).

Chapter 5 of this DoCPI is my original research manuscript, which exemplifies data analysis and collaboration with peers to disseminate research to the larger body of athletic trainers. It serves as evidence of my willingness to participate in and disseminate scholarship. The manuscript is, thematically, within my chosen area of advanced practice (apparent hamstring tightness) and will be submitted for publication to a journal for the benefit of a larger body of athletic trainers. It is my hope that the multi-site research findings will help many clinicians with their clinical cases of hamstring tightness, which, in turn, will help more patients with their complaints of hamstring tightness.

This project also helped me to establish a future line of scholarly research. In order to create a treatment-based classification system that will help clinicians to identify and treat patients with hamstring tightness more effectively, I plan on systematically observing the efficacy of additional alternative treatment methods for increasing hip flexion or knee extension range-of-motion. After graduating, I plan to publish studies on the reliability and validity of the V-Sit and Reach test, on a survey of athletic trainers' perceptions about the evaluation and treatment of hamstring tightness, and on the long-term effects of Total Motion Release (TMR) on hamstring tightness.

In addition to highlighting my dissemination of scholarship, Chapter 5 of my DoCPI is evidence of my ability to analyze data and of my collaboration with other clinicians. The patient-care manuscript was a multi-site research project and involved coordinating with colleagues and peers to obtain a large population size. Personally, I found that working on multi-site research with other individuals strengthened my resolve, work ethic, and attention to detail, and, ultimately, made a product with higher power and greater external validity in a shorter amount of time than if I had attempted to perform the research individually.

Writing the patient-care manuscript also tested my knowledge and application of data analysis. I was able to practice running appropriate statistical analyses in order to answer a specific research question. One must have a basic knowledge of the options available for both parametric and non-parametric data analyses, as well as the ability to carry out the analyses and participate in a meaningful discussion of results. Chapter 5 illustrates how I developed research questions, collected data, and then chose appropriate statistical analyses to answer the research questions in a way that made the most sense to readers. Thus, Chapter 5 of my DoCPI is evidence of my ability to research and disseminate information, collaborate with peers, and analyze data to benefit the larger community of athletic trainers and patients.

The DoCPI is intended to provide evidence of my abilities and my growth as an advanced practitioner. In the Chapter 2 PoAP, I will introduce my journey to becoming an advanced practitioner and will outline my plan for sustainable improvements using EBP and PBE. Chapter 3 will highlight my ability to perform local action research and clinical reflection by presenting PROMS and select journal entries from the last two years of my residency. Through my CATs in Chapter 4, I will evidence my ability to critically appraise peer-reviewed articles and establish an area of advanced practice in apparent hamstring tightness. Chapter 5, which is the concluding chapter of my DoCPI, is my patient-care manuscript. It illustrates my dissemination of scholarly work, my collaboration with colleagues, and my ability to analyze data. Collectively, this DoCPI demonstrates how my journey in the DAT has revolutionized my personal, professional, and clinical practice growth. Consequently, it shows how I will continue to improve my practice to make a positive impact on the lives of many patients, colleagues, and students for years to come.

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CHAPTER 2

PLAN OF ADVANCED PRACTICE

Introduction/Narrative

Advanced practice can be defined as the scholarly pursuit of a chosen clinical focus area beyond the generally accepted knowledge of practice (Nasypany, Seegmiller, & Baker, 2012). It develops through thoughtful appraisal of strengths and weaknesses, planning, goal setting, and implementation of clinical techniques in a chosen area of practice. My personal journey toward advanced practice began when I enrolled in the doctorate of athletic training (DAT) program at the University of Idaho. As I began this journey, an article by Ken Knight and Chris Ingersoll on the subject of scholarship reformed my thoughts on what it means to be an advanced practitioner in athletic training: "Scholarship, like fine wine and cheese, develops over time; it is not something that is bestowed upon a person" (Knight & Ingersoll, 1998). Knight and Ingersoll's article reinforced my growing understanding of how scholarship and, therefore, advanced practice is a lifelong pursuit.

The Plan of Advanced Practice (PoAP) is a student's guide for personal and clinical development within the profession of athletic training (Nasypany et al., 2012). My PoAP, which is found in this chapter, contains a reflection on my personal journey into the athletic training profession, an assessment of my knowledge in the profession, a declaration of my specific areas of advanced practice and an explanation of why I chose those areas, an examination of my current strengths and weaknesses as an AT, and an outline of my plan for continued growth as an advanced practitioner.

Reflection on Professional Experience and Development

To grow as an athletic trainer (AT), I knew that I must first begin by reflecting on my journey into the profession. My journey as an AT began in 2005 as a freshman at Frostburg State University. As an ambitious student, I excelled in my classes, but I had difficulty choosing a major. I considered geography, theater, psychology, and parks and recreation, but it was not until the spring of 2006, when I experienced an anterior cruciate ligament (ACL) and meniscus injury while playing indoor soccer, that I received my calling.

My injury and recovery led me to become interested in health care and in the practice of helping people cope, emotionally, with traumatic and disabling events. I was not given a prescription for physical therapy after receiving knee surgery; rather, I was left to my own devices to determine my rehabilitation goals and exercises. I pored over books, internet articles, and other sources to find rehabilitation strategies. Specifically, I learned new weight bearing and non-weight bearing exercises, along with the timeline and physiologic processes for tissue healing. Throughout the recovery process, I experienced the physical and emotional toll that an injury takes on a person. As a result of the adverse experiences I had as a patient, I garnered passion for helping others through their own mental and physical struggles during rehabilitation. This passion is what helped me to readily adopt a whole-patient care approach as I began my DAT degree, many years later. I did not realize it at the time of my injury, but at the moment, I no longer had to worry about choosing a major, because Athletic Training had, in a sense, chosen me. Thus, in spring of 2007, I began to pursue a career as an AT.

Throughout the remainder of my undergraduate education, I formed my initial perceptions of the profession, and identified my affinity for book knowledge instead of practical clinical skills. I performed well, academically, and achieved a high GPA; however, I did not make the most of my clinical experience at Frostburg State University. As a result, I graduated with doubt in my rehabilitation abilities and not ready to make decisions on my own regarding the healthcare of patients. Additionally, my perception of athletic training upon graduating was that ATs should "be all things to all people." This idea arose from viewing other athletic trainers being required to perform tasks from filling up water bottles to spending hours providing "coverage" at practices, instead of spending a majority of time with patients in rehabilitation. After these experiences just prior to graduation, I realized that the profession and athletic training educational model were in need of some major changes if athletic trainers' patient care was going to improve. Thus, my experiences in my undergraduate education prepared me to quickly adopt the principles of patient-centered care that the DAT program instilled in me years later.

In the winter of 2010, I interviewed at The University of North Carolina (UNC) Chapel Hill for their athletic training program, and, as a result, received an invitation to join their program. Because the program at UNC was prestigious and only offered 10 positions for paid graduate assistantships, I had to make my decision within 24 hours. I had heavily considered pursuing physical therapy at Drexel University, where I had an interviewed lined up, but ultimately I chose athletic training instead of physical therapy because UNC required a quick answer. I thought that if I were to pursue UNC, with its exposure to teaching, physical therapy, college sports, and research, I would be able to choose between clinical practice, teaching, and research for my career. I saw the roles of clinician, educator, and researcher as three distinct roles, at that point. This view would later change, as I was exposed to advanced practice concepts in the DAT program.

At UNC, I learned both positive and negative aspects of all facets of the AT profession. I worked with the football team for two years as I studied, taught, worked in a physical therapy clinic, and conducted my thesis on ankle dysfunction and balance. The two years at UNC were easily the busiest time in my life up to that point, and I was close to quitting on more than one occasion. I am grateful that I did not quit, however, because at UNC I was able to learn valuable manual therapy skills, such as the Graston® Technique. Additionally I learned about the National Academy of Sports Medicine's model for approaching evaluation and rehabilitation. I also learned important note-taking and rehabilitation skills when I participated in the program's physical therapy rotation.

Although I learned valuable information at UNC, a majority of my clinical experience was not focused on improving my patient care. In my position as a graduate assistant for a Division One football team, athletic trainers were viewed as a "cog in a machine." Instead of the having challenges that required critical thinking in patient-care, the full-time positions with the football team delivered frustration, burnout, and a lack of job satisfaction. I saw my original reason for pursing athletic training (the science of healing, and the ability to help people cope with their physical pain), become distant, as I was turned into a work horse, doing jobs that I felt a person without a formal education could do. I enjoyed taking classes, teaching, and my physical therapy rotations at UNC, but I did not largely enjoy my clinical rotation as an athletic trainer. Ironically, the thought that becoming a teacher would eliminate clinical responsibilities was actually what fueled me to progress in my graduate studies in athletic training at UNC.

Due to my weakness in clinical skills, I did not feel confident in my ability to improve patient well-being. In the future, through the DAT program, I would realize that in order to be an effective teacher, I would need to be a better clinician; however, during my second semester in the UNC program, I just wanted to be out of the clinical profession.

Immediately after graduate school, I accepted a position at Erskine College in South Carolina as the Clinical Education Coordinator and Athletic Trainer/Instructor. My time at Erskine College was a great time of learning for me. I came across clinical scenarios and injuries that I had not seen before, and I dealt with countless emergencies. However, after working at Erskine College for two years, I felt stagnant in my practice and was starting to become burnt out with the hours and with the travel that was required of me. Because Erskine is a small college that is enrollment-driven, the athletic trainers were starting to see large rosters on all of the sports teams, which made my assignment as AT to the soccer team almost unmanageable (58 players on the roster for a varsity-only team). My motivation for pursuing a doctorate was fueled by a desire to escape from my numerous clinical duties, patient care, and long hours. Additionally, I knew that if I pursued further schooling, I would be able to provide for a family and have better hours to spend with my children in the future.

After searching extensively, I found the Doctor of Athletic Training (DAT) program at the University of Idaho. This program enticed me, because it offered the ability to continue to work while I pursued a doctoral degree that was directly related to my profession. I asked my institution if they would help support me in my endeavor to pursue an advanced degree, and they agreed. I applied to the DAT program and was granted acceptance into the class of 2016.

My first year in the DAT program was spent in residency at Erskine College, where I worked to improve my patient care and instruct students in the athletic training program (ATP). I finally began to feel empowered and to believe that I could change the profession of athletic training. In spite of all of my years of frustration with the profession and my poor clinical skills, I was encouraged that many others saw the obvious dysfunction within athletic training and chose to pursue change rather than hide from it. My moment of major epiphany came when Dr. Alan Nasypany discussed the roles of clinician, educator, and researcher as being one. For years, my choice to be an educator was driven by the fact that I could flee what I perceived to be the negative aspects of athletic training (e.g., long hours, filling up water bottles, low pay). After thinking about my motivation for having made the decision to teach, I realized my folly: I had believed that I could escape the clinical aspects of athletic training even though, as an educator, I would be teaching others in those same aspects of the profession. It did not make logical sense for me to be teaching other students in a discipline that I did not even want to pursue, myself. The DAT program reformed my thinking and helped me to realize that in order for me to be an effective educator, I must also be an effective clinician and clinical researcher. The three roles are intertwined and cannot be separated if I am to be an effective mentor of future athletic trainers. In addition to this change in my philosophical beliefs about athletic training, I was given practical, effective clinical skills that empowered me to improve my patient outcomes quickly.

After a year of growth and reflection (which will be addressed later, in my reflection on my strengths and weaknesses), I was forced to look for new employment for financial reasons. In the summer of 2015, I accepted a full-time faculty position at Waynesburg University and began my career as a full-time educator. In my new position, I have not forgotten the lessons I have learned up to this point. As I grow in my own knowledge of patient care and clinical action research, I will continue to develop as an educator. Additionally, I have discovered a renewed sense of responsibility to be an ambassador for change in patient care and critical thinking. I am currently using my knowledge to encourage students to pursue their own clinical research for the purpose of improving their local clinical practice. With the principles I have learned in the DAT program, I have come to understand my responsibility to grow in knowledge and expertise as I work to educate students and improve my own patient care. This PoAP will facilitate a strengthening of my clinical practice and will help me to develop as an advanced practitioner. After reflecting on my journey into athletic training, the next step in developing into an advanced practitioner is to assess my current professional knowledge to aid me in selecting areas of advanced practice.

Assessment of Current Professional Knowledge

Assessing one's current knowledge within a profession is the first step to realizing strengths and weaknesses that may be improved upon in the future. As I reflect on my current clinical competence, I find it necessary to define the standard I am using to rate my knowledge in athletic training. The content areas of athletic training knowledge, as outlined by the Board of Certification (BOC) for athletic training, are: injury/illness prevention and wellness protection, clinical evaluation and diagnosis, immediate and emergency care, treatment and rehabilitation, and organizational and professional health and well-being (Johnson, 2010). At the beginning of the DAT I considered myself to be proficient or slightly above average in all areas. Specifically, if I had used a 5-point rating scale, with 1 being novice/entry-level and 5 being expert, I would have rated myself as a 3 in all areas. This rating would have been derived from the fact that I passed my BOC exam on the first try and had post-graduate education at UNC Chapel Hill.

By completing the DAT program, I have come to understand that there is more to being an advanced practitioner than simply being proficient in the minimal content standards or having years of experience. Specifically, advanced practice involves a continual process of growth in knowledge of specific content areas. It also involves setting goals for improvement, implementing new knowledge, and then reflecting on the knowledge acquired. Consequently, the standard I use to rate my current knowledge of athletic training has grown to include more content areas than simply the basic areas of knowledge. If I were to rate my current clinical knowledge using the aforementioned 5-point scale, I would rate myself as a 3 in most areas. My score would be the same as it was when I first began the DAT program not because I do not believe I have improved, but because my standard of practice for myself has become higher. Thus, if I had to retrospectively rate my level of knowledge in athletic training at the beginning of the DAT, I would give myself a 1 or a 2 in most content areas. Through my studies in the DAT program, I have learned to strive for improvement in all areas of athletic training. As

I grow, I must choose several areas in which to become an expert. The following section of this PoAP contains more information about these chosen areas of expertise.

Areas of Advanced Practice

Identifying areas of advanced practice is important because it combats the "be all things to all people" mentality that has been instilled in athletic trainers for so many years. By choosing to excel in specific areas beyond the generally accepted knowledge of athletic training, advanced practitioners will be able to disseminate their knowledge and expertise in their chosen areas to other medical professionals. Advanced practitioners will therefore garner the respect of other allied healthcare and healthcare professionals, while also advancing their skills for treating patients more effectively. The specific areas of advanced practice that I have chosen to pursue are evaluation and clinical reasoning skills, the application of manual therapy techniques, lower extremity chronic muscle injuries, and teaching and pedagogy within athletic training. In the following section, I will discuss my personal strengths and weaknesses as well as my strengths and weaknesses in each area of advance practice.

Examination of Current Strengths and Weaknesses

Knowing my personality strengths and weaknesses will aid me as I strive to improve my patient care and disseminate information to students and healthcare professionals. Reflecting on my strengths will allow me to set goals that will utilize them to my fullest potential. Likewise, knowing my weaknesses will allow me to set goals that will address my shortcomings and build upon them for improvement in the future. In addition to assessing my general personality strengths and weaknesses, I will assess my strengths and weaknesses in each of my specific specialty areas in further detail.

Personality Strengths

As I consider my strengths in athletic training, it is helpful to assess my personal gifts and how they may contribute to my growth in athletic training. To assess my personality, I have found the Myers-Briggs Type Indicator (MBTI) to be a helpful tool. I have taken the MBTI exam on a few occasions over the past five years and have had fairly consistent results in the assessment of my personality traits. The

MBTI exam assesses personality on 4 different criteria levels, categorizing people into 16 possible personality types (The Myers and Briggs Foundation, n.d.). The four criteria levels are: Extroversion (E) vs. Introversion (I), Sensing (S) vs. Intuition (N), Feeling (F) vs. Thinking (T), and Perceiving (P) vs. Judging (J) (The Myers and Briggs Foundation, n.d.).

On every MBTI exam I have taken, from undergraduate to graduate school, my extraversion and intuition are my strongest characteristics. I enjoy being around and meeting new people and am generally energized by talking to a wide variety of people every day. Because I interact with students and patients on a daily basis, my extroversion has proven helpful to me in my career. My intuition can be a strength to me in the role of educator, because I enjoy novel ideas and new information, and I like to see the deeper meaning rather than the superficial circumstances of events. Regarding whether I am a “thinker” or a “feeler,” the MBTI exam indicates that my personality is almost equally both. Because I enjoy problem solving and rationalizing, I tend to lean slightly toward thinking. But I also care about people’s feelings and will try to avoid hurting others if at all possible. I am also close to equal in the judging and perceiving areas of my personality, although recent tests have trended toward “judging.” The judging personality is one who plans, makes lists, and takes notes and likes to be organized, whereas the perceiving personality is more flexible, adaptable, and does not care as much about deadlines or timelines.

Most recently, my formal profile reading was Extraversion, Intuition, Thinking, and Judging (ENTJ). According to the Myers Briggs explanation of the personality types, ENTJ types are “usually well informed, well read, enjoy expanding their knowledge and passing it on to others” (Myers and Briggs Foundation, n.d.). I believe that my personality strengths are best used in an academic setting in athletic training where I can explore and deepen my understanding of advanced concepts and then disseminate that knowledge to others.

My faith has also been a strength to me, and I am blessed to incorporate it into my work setting at a private Christian institution. Because I like to focus on the “big picture” and philosophical ideas, I often remind myself that my students will not be able to remember the intricacies of the concepts I am teaching them 30 years from now, but they will remember the life lessons they learned while in school and the faith they developed as a result of those life lessons. There are more important things in life than knowledge of athletic training. I believe that one of the greatest strengths that I possess is being able to offer my students lasting knowledge of Jesus that will have bearing on this life and also the life to come. Overall, I can use my personality strengths and leadership skills in the profession of athletic training to mentor others and teach concepts to others as I perform in my faculty role at a Christian university.

Personality Weaknesses

In addition to my strengths, I also have weaknesses associated with my personality, of which I must be cognizant while pursing my advanced practice. First, I have a tendency to measure my merit in terms of my successes and my achievements; as a result, I am an extremely driven person. Working hard has its benefits, but it sometimes causes me to suffer from burnout. Burnout can lead to narrow vision and a lack of ingenuity. Second, I am a “people-pleaser.” This is a strength when I am serving others; but it is a weakness when I allow others’ opinions of me to affect me adversely. If I receive a negative comment or criticism, I tend to think very deeply about it for a long time. I must continue to work on this weakness as I grow in my knowledge and in my profession, and I must understand that acceptance from others is not necessary for growth. Third, I frequently overanalyze situations. When I am faced with an important decision, I prefer to gather all of the information I can and think through everything rationally. This may be a strength in certain cases where much thought and consideration is required; but when taken to the extreme, my analytical mind may cause me to become paralyzed and unable to take action. If I think I may make a mistake, I will almost always rescind and become more thoughtful, allowing others to step in and take the lead, which hinders my capacity for leadership.

Evaluation and Clinical Reasoning Skills

Strengths

Before I entered into the DAT program, my evaluation skills were similar to most ATs, and my method of evaluation—the HOPS (History, Observation, Palpation, Special Tests) method—was commonly used. Once I finished following the HOPS method for evaluation, I developed a diagnosis and kept differential diagnoses in my mind. I would then formulate a rehabilitation program based on the diagnosis and would have the patient progress with their exercises. When I began the DAT in the summer of 2014 I began to reflect on my evaluation methods and realize that they had not been individualized to each patient. For example, if I had seen a patient with Medial Tibial Stress Syndrome (MTSS), I would have pulled up the "Lower Extremity Injury" rehab template on my computer, made a few minor adjustments based on patient limitations, and then printed it out for the patient. What I had not realized until I performed my reflection on my pre-DAT method of evaluation, was that I had not treated my patients as effectively as I could have treated them, because I had not evaluated them as thoroughly as I should have evaluated them. I realized that instead of having treated each case based on the location of pain, I should have evaluated dysfunction elsewhere in the body to determine the cause of pain. Then I should have designed my rehabilitation program based on my evaluation. I had also not thought critically about my patients when I gave them a pre-determined program and told them that it would take some time for them to get better. As a result, my patients' pain had been slow to improve.

My current rehabilitation philosophy incorporates the concepts of regional interdependence (RI) and treatment-based classification (TBC). Regional interdependence is a theory which states that the location of pain is not usually the cause or source of the pain (Wainner, Whitman, Cleland, & Flynn, 2007). Treatment-based classification involves using treatments as a means of classifying a patient and choosing an intervention based on the patient's immediate response to the initial treatments applied (Chevan & Clapis, 2013).

The theory of RI led me to abandon my standardized approach to rehabilitation and to search for causal factors outside of the area of pain in my evaluation. Factors may be, but are not limited to the following dysfunctions: joint mobility, stability and motor control, tissue extensibility, psychosocial, neurologic and breathing. Therefore, my current philosophy on chronic pain patient rehabilitation involves using global assessments to discover the potential causal factors of pain. These assessments include the Selective Functional Movement Assessment (SFMA), Total Motion Release (TMR), and breathing pattern disorder evaluation. Treating chronic pain from a regional interdependent perspective is a strength because it allows me to discover the source of pain, instead of simply identifying the location of pain.

In addition to reforming my rehabilitation philosophy to include an evaluation that uses regional interdependence, I have also incorporated a model of TBC. Using the TBC approach to pathology, along with RI, aids me in identifying dysfunctional areas and determining whether or not the patient's pain resolves immediately when I address the dysfunction in those areas. Based on the patient's response to my treatment, I can determine the most efficacious forms of treatment for that particular patient. As a result, my patients improve faster than if I utilized the non-individualized approach to rehabilitation that I was accustomed to using before I enrolled in the DAT program.

Weaknesses

Although I have reformed my approach to evaluating chronic pain patients, I still have room for improvement. Specifically, I must practice and learn more about the evaluation paradigms that I frequently use (such as the SFMA and TMR). I am systematic in my approach to patients; however, I tend to overanalyze my patients by gathering too much information and getting "stuck." I must work to improve my evaluations by using intuition and knowledge and by simply trying techniques to classify patients based on their response to those techniques. Additionally, I must improve on evaluating the shoulder and upper extremity. Although I have had experience with shoulder evaluations, I still do not feel confident in my ability to thoroughly evaluate and identify joint mobility dysfunctions or tissue extensibility dysfunctions in this region. I am also not efficient with performing upper extremity breakouts using the SFMA model. Another of my weaknesses in the area of evaluation skills is that I have not aptly included breathing pattern disorder assessment in all of my patients who present with chronic pain. Assessing patients' breathing should be the first step in evaluating all chronic pain patients, because it may be one of the most influential factors in decreasing pain sensations and postural abnormalities (Chaitow, Gilbert, & Bradley, 2013). Lastly, as I have started collecting outcomes regularly, I have found myself becoming more tense and rigid while I conduct my evaluations. Instead, I should be relaxed and should talk to my patients as *people*. In failing to do this, I have lost one of the principle components of patient care, which is a personal connection that shows trustworthiness and care of the patient.

Application of Manual Therapy Techniques

In addition to my evaluation and clinical reasoning skills, I have identified another area of advanced practice: the application of manual therapy techniques for the treatment of injury. Manual therapy is effective at relieving pain quickly for a variety of conditions (Camarinos & Marinko, 2009; Villafañe, Pillastrini, & Borboni, 2013). Additionally, manual therapy is valuable, because it allows me to treat patients without the use of any aids other than my mind and my hands. Being able to treat patients without using aids or devices fosters critical thinking rather than simply "going through the motions" by using modalities. Currently, my sub-areas of focus within manual therapy involve the use of the Mulligan Concept (MC) and Neurodynamics (NDS).

Before I entered into the DAT program, my approach to rehabilitation was one-dimensional. I was aware that I should not be making standardized programs; however I was still assigning the same types of strengthening exercises and balance exercises for all of my patients who had the same diagnosis. I needed a new technique that could individualize the patient's treatment and aid me in improving my patient outcomes more rapidly than stretching and strengthening exercises.

During the DAT program, I was introduced to a variety of new manual therapy treatment techniques and evaluation methods that have made me rethink how I approach a treatment program. Instead of thinking of a rehabilitation program as a long duration time in which exercises that have been designed to strengthen muscles are performed, I now realize that manual therapy interventions may provide my patients with instant pain relief and may help to remove potential causal factors for pain in my patients.

Mulligan Concept

Strengths

To become adept at utilizing the MC, I have taken two workshops (Upper Extremity an Lower Extremity), read *Manual Therapy: NAGS, SNAGS, MWMs, etc.* (Mulligan, 2010), and have watched video seminars on how to properly think through and apply Mobilizations With Movement (MWM) for all areas of the body. Additionally, I have improved my technique with the MC by studying the patient-rated outcomes measures (PROMs) associated with the lateral ankle MWM in my clinical practice.

As a clinician, I regard my ability to understand and explain the theoretical concepts behind MC to be one of my strengths. I have focused much of my advanced study on the lower extremity, so I am more adept at applying the MC to that area than I am at applying it to the upper body.

Weaknesses

I have not yet identified the most effective hand placement for each MC technique, especially when working with the upper extremity. If I can continue to practice my hand placement, I will be able to grow in future years in my ability to successfully use the paradigm. I have not yet studied MC in an *a priori* case design, and I need to be more systematic about how and when I apply the MC to my patients.

Neurodynamics

I chose to focus my clinical research on NDS and the application of this technique on patients with MTSS. As a result, I have learned much about the theory and application of NDS for treating lower extremity pathologies. In addition to reading about the theory and its application and studying NDS in my own practice using PROM and multi-site case-series, I also have an article in review on the use of NDS for increasing range of motion in the lower extremity. I will also be the primary lab instructor for teaching how to use NDS on the lower extremity at the NATA National Symposium this year.

Strengths

My strengths with NDS are my understanding of the theory how the technique works and how it can be applied for lower extremity pathology. Integral to my understanding of NDS theory is the seminal work by Maitland (1979), in which he explains the excursion of the nerve with cervical flexion and dorsiflexion ROM. I then read an article by Shacklock (1995), in which the he detailed the concepts of mechanosensitivity. Mechanosensitivity is a theory that explains that movement of the nerve through manual therapy stretches the dura matter at the nerve root, potentially decreasing peripheral perception of pain. After reading *The Neurodynamic Techniques* (Butler, 2005) and attending a peer presentation, I learned about how to apply the theory to my practice through NDS screening and treatment methods. I was able to use my knowledge on lower extremity chronic conditions such as MTSS and Achilles tendinopathy, which are highlighted in Chapter 3 of my DoCPI.

Weaknesses

One of my weaknesses with NDS is my lack of experience with using passive NDS techniques for the upper extremity. I also have not taken a course in NDS, so I do not know if I am performing it in the most effective way possible. Additionally, I have not yet read all of the published books on the topic of NDS, including *Clinical Neurodynamics: A New System of Musculoskeletal Treatment* which would further my understanding of the concepts and application of the technique (Shacklock, 2005).

Treatment and Management of Lower Extremity Chronic Muscle Injuries

The broad area of advanced practice that I have chosen is the treatment and management of lower extremity chronic muscle injury. I have chosen this area because I have had personal experience with lower extremity injuries, and many of my patients have also struggled with these injuries. It is my goal to effectively reduce recovery time for chronic pain patients through the use of the clinical evaluation and manual therapy skills that I listed earlier.

Strengths

My strengths in the category of lower-extremity chronic muscle injuries are the evaluation and treatment of hamstring tightness, MTSS, patellar tendinopathy, and Achilles tendinopathy. The specific injuries listed above are injuries that I have studied in depth in my clinical practice as well as in the existing literature. Through translational research and my evaluation and manual therapy techniques, I will continue to further my knowledge of these specific pathologies as I progress in my area of advanced practice.

Weaknesses

There are still many injuries that I can explore which fall into the category of lower extremity chronic muscle injuries. For example, I have not explored plantar fasciitis or iliotibial band syndrome in my clinical practice. However, I do plan to expand my knowledge in this area by treating patients who present with these conditions, and reflecting on my outcomes. As I try new techniques aimed at psychosocial causes, such as breathing pattern re-training and trauma releasing exercises, I will be able to more effectively classify patients based on their potential causal factors and will be more effective in eliminating their long-term pain.

Teaching and Pedagogy within Athletic Training

Now that I am a full-time faculty member, I have begun to formally explore the practice of effective teaching. Although I have no formal training in pedagogy, I have attended conferences and read books that address the subject of how to speak to and teach others, effectively. If I were to rate my teaching expertise using the 5-point scale that I used previously, I would rate myself at a 2 because I know I have barely scratched the surface of learning what it takes to be an effective educator, especially within the profession of athletic training.

Strengths

My strengths as an educator are that I am organized and have a gift for speaking publically. I enjoy speaking in front of large groups of people and trying to break down and explain concepts that are advanced. I am also genuinely excited when I am able to help others grasp concepts and learn ideas that will empower them to pursue their goals. Additionally, comments I have received from students on my teaching evaluations have supported my belief that two of my strengths as an educator are my general enthusiasm about the topic I am teaching, as well as my expression of concern and care for individual students. Aside from my natural gift for teaching, in 2012 I attended a New Faculty Conference for Christian Universities on pedagogy in Philadelphia, which was my first exposure to formally studying what effective pedagogy entails.

Weaknesses

I have many areas in which I must improve in athletic training education. First, I must grow in my knowledge of teaching practices. My current workplace has programs, book discussion groups, conference money, and other resources that I hope to take advantage of as I endeavor to learn more about effective teaching. Second, I must grow my practice by learning how to better structure my courses so they encourage long-term retention of information. Third, I must learn how to effectively teach preceptors how to educate students more effectively in a clinical setting. As my knowledge of pedagogy grows, I will be able to identify and implement new techniques that will help me to develop as an effective teacher. Lastly, I tend to not be very creative in the classroom and to teach using a typical, lecture-style format. I know that my students will benefit more from interaction and from being challenged by abstract and critical thinking; therefore, I will incorporate formats that include these criteria into my teaching practices.

Table 2.1: Summary of Strengths and Weaknesses

	Strengths	Weaknesses
Personal Attributes	1. Extraverted: enjoy people 2. Intuitive: enjoy the novelty of learning new ideas 3. Thoughtful: think deeply about problems and apply meaning to them 4. Judging: stay organized, persevere, and make lists to stay on task 5. Faith-filled: guided by faith as I mentor students, treat patients, and strive to love others with a Christ-like love.	1. Tend to burn out from overwork 2. "People-please": I am too concerned with how others perceive my actions 3. Overanalyze: think about the intricacies of a problem to the point where I am paralyzed and unable to take action 4. Personalize critical feedback from those whom I respect
Evaluation and Clinical Reasoning	1. Approach evaluation using regional interdependence theory: address the cause of pain, not the location 2. Use global evaluations such as the Selective Functional Movement Assessment to determine cause 3. Use treatment-based classifications to categorize patients based on how they respond to interventions 4. Solve problems using analytical mindset and knowledge of anatomy 5. Evaluate and classify chronic lower extremity injury	1. Overlook the psychosocial components of patient care during evaluation 2. Overanalyze during evaluation, treat the body like a machine and forget about the person 3. Neglect to globally assess shoulder and upper extremity 4. Have thus far failed to attend shoulder and upper extremity breakouts with the SFMA 5. Do not use Breathing Pattern evaluation regularly
Manual Therapy Interventions	1. Explain Mulligan Concept (MC) theory to patients 2. Apply MC to lower extremity 3. Understand Neurodynamics (NDS) theory 4. Apply ND to lower extremity	1. Do not know correct MC hand placement for upper extremity 2. Neglect to perform NDS screening on a regular basis 3. Do not use ND treatment for upper extremity 4. Fail to incorporate new paradigms: Total Motion Release, Breathing Pattern Disorder Treatment
Lower Extremity Chronic Injuries	1. Use evaluation and manual therapy strengths to classify and treat patients who present with this category of pain 2. Evaluate and treat hamstring tightness from a regional interdependence perspective 3. Evaluate and treat medial tibial stress syndrome from a regional interdependence perspective 4. Evaluate and treat patellar tendinopathy from a regional interdependence perspective	1. Do not have experience treating iliotibial band friction syndrome 2. Am not able to improve patient outcomes for patients with Achilles tendinopathy rapidly 3. Do not have experience treating patients with plantar fasciitis
Teaching	1. Speak with analogies and break down difficult concepts 2. Demonstrate enthusiasm for content material 3. Show compassion for students	1. Lecture too much rather than challenging and guiding 2. Do not know the best teaching practices 3. Fail to structure course in effective manner

Plan for Continued Growth

Currently, I am blessed to be a full-time faculty member at a Christian university. I enjoy being at a Christian university because I can utilize my unique gifts to instill lasting values in my students as I teach them about Christ and how to help other people. Although I am in the setting and role that I believe I will enjoy more than any other, I know that I will always have the desire and opportunities to improve my service to others. Therefore, I have set individual goals for my growth as an advanced practice clinician, educator, and researcher in the profession of athletic training.

As I identified in Chapter 1 of my DoCPI, I have learned that although my primary goal is to be an educator within the profession of athletic training, the roles of clinician, researcher, and educator should all be one role. Without clinical expertise, I would not be able to effectively educate students on how to be a clinical athletic trainer. I would lack the knowledge necessary to improve the well-being of patients. Therefore, my goal in the following section is to build upon my strengths and weaknesses in the categories of clinical practice, research, and education, to develop a plan for my future growth as an advanced practice athletic trainer and educator.

Clinical Goals

As I plan how I will accomplish my future clinical goals, I am reminded that my goals may change in the next five years based on my evaluation of clinical practice through the concepts of EBP, PBE, and translational research. Sustainable clinical growth may only be achieved through continual scholarship and the evaluation of one's practice for the purpose of improving it. Additionally, I plan to improve as a clinical athletic trainer by furthering my education through reading, workshops, and referral practice, and by combating the weaknesses that I identified in my earlier "Examination of Strengths and Weaknesses." First, I will further my education in the area of clinical practice by reading material related to new manual therapy techniques and focusing my reading on the psychosocial aspects of intervention and evaluation. Specifically, I plan to continue my study of breathing pattern disorders and how the evaluation and treatment of breathing pattern disorders may affect lower extremity chronic injuries.

Additionally, after graduating from the DAT, I would like to take the Lower and Upper Quarter 1 courses offered by Neurodynamic Solutions to learn more about the technique from professionals. I would also like to take the upper extremity MC course to improve on my weaknesses with hand placement for the upper extremity. Lastly, to build upon my foundation in manual therapy and patient-empowering techniques, I will use EBP as I practice TMR. I will explore the efficacy of TMR for a variety of conditions and will utilize PROMs to assess the technique.

I also plan to build on my patient-referral practice. In the role of full-time faculty, one of the advantages I have in studying clinical athletic training is that I am able to ask that specific injuries be referred to me. After I began my referral practice in residency, I discovered that I could perform *a priori* research much more effectively than in my first two semesters of residency. For example, I was able to study a series of patient cases for MTSS. Therefore, in the future, I will focus on planning an *a priori* study of iliotibial band syndrome, plantar fasciitis, and Achilles tendinopathies.

Lastly I will continue to mentor students in clinical practice by instilling in them an understanding of the concepts of EBP and reflection. I plan to teach the concepts of EBP to my students by having them identify a common injury in their clinical rotation, collect patient outcomes on patients with the identified injury, and analyze the efficacy of their treatments by reflecting on their PROMs. By the time the students are seniors, I hope to have them plan out an *a priori* case study, similar to those I have completed. The case study will help the students to think critically about their clinical decision making. To promote a reflective style of practice, I will require my students to write monthly journal entries about their clinical rotation experience. I plan to foster the students' reflections by giving critical feedback on journal entries and asking questions about the decisions they made in their patient care.

Research Goals

In the future, I will expound on the foundational research on apparent hamstring tightness that I have completed with a group of six peers in the DAT. I have discovered that there are major advantages to working with my peers and performing multi-site research. We already enjoy a great working relationship, and we are efficient at accomplishing writing and research tasks. I plan to collaborate with my peers to pursue our dissertation topic of addressing apparent hamstring tightness and to test various treatments. Eventually, I plan to create a treatment-based classification system for categorizing and treating patients who present with hamstring tightness. Currently, we pursue questions that have arisen from our research of hamstring tightness. In regards to my own research of hamstring tightness, I plan to study and publish on the follow topics: (a) the reliability and validity of the V Sit-and-reach, (b) the validity of a new perceived-tightness scale, (c) the practices of athletic trainers in treating and assessing apparent hamstring tightness, and (d) the utilization of Mulligan Traction Straight Leg Raise for improving range of motion in patients with apparent hamstring tightness. Group accountability will also help to keep me on task with my goals.

Education Goals

In addition to my research aspirations, I plan to focus on becoming a more effective athletic training educator. Although my clinical skills have improved significantly while I have been in the DAT program, and my research skills are above average because of my background at Chapel Hill and my clinical residency in the DAT program, I find that I need to improve as an educator. I have not formally studied teaching strategies, so I have a difficult time understanding how to effectively facilitate my students' learning process. In an effort to rectify this problem, I plan to attend the National Athletic Trainer's Association Educator's Conference in 2017. I also plan to read more books on pedagogy, including *How Learning Works: 7 Research-Based Principles for Smart Teaching* (Ambrose et al., 2010). I hope to use concepts found within these books with seasoned experts in teaching, especially those in the profession of athletic training. After I finish reading the aforementioned books, I plan to continue to search for literature on the subjects of clinical pedagogy within professions that are related to athletic training, such as nursing. Lastly, I plan to research pedagogy in my own practice, so I can determine which of my teaching styles prove to be the most effective. I will use the feedback from my student evaluations to continue to adjust my teaching style and to make my methods more effective.

Professional Leadership

Finally, although I have not yet directly served on a global scale as a leader in the athletic training profession, I have given much thought to how I can do so. Professional leadership involves serving the profession on a large scale, through volunteering, serving on committees, reviewing journals, participating in various organizations, and more. There are a number of benefits to volunteering within the healthcare profession. These include the acquisition of new skills, access to peer networks, and improvement in teaching skills to others (Alspach, 2014). Prior to embarking on my journey through the DAT program, I did not give much thought to the idea of serving or volunteering on a large scale. As I have progressed through the DAT program and have become more knowledgeable as an AT and more confident in my skills as a medical professional, I have come to recognize my responsibility to be an ambassador for change within the profession. I can do this by placing myself in positions of influence. Therefore, after I earn my DAT degree and become more adept at my job (preferably after about five years of teaching and focusing on improving my pedagogy and local practice), I would like to pursue leadership within the profession of athletic training by serving or volunteering with the NATA and the Christian Sports Medicine Alliance (CSMA).

My primary reason for wanting to serve the larger body of ATs in a leadership capacity is so I can positively influence the direction in which the profession moves. Specifically, by serving in the NATA, I hope to disseminate principles I have learned in the DAT program, such as the importance of local action research, TBC, RI, and an advanced practice doctorate model. In regards to my volunteer service to the CSMA, the organization's CEO and I have already discussed my contributions to the formation of materials for athletic trainers who are coping with the loss of a patient or with a traumatic injury. I have identified a need for athletic trainers to comfort other athletic trainers who may be struggling with feelings of guilt, regret, or remorse for decisions they made leading up to traumatic events. It is my goal to work with the CSMA in order to benefit the greater community of athletic trainers in whatever way I can.

Table 2.2: Plan of Advanced Practice Goals

Area:	Goal:	Timeframe for completion:	Method of assessing goal:
Clinical	1. Acquire further knowledge of psychosocial aspects of evaluation and treatment 2. Continue practice of psychosocial aspects of evaluation and treatment 3. Study iliotibial band syndrome and plantar fasciitis 4. Improve use of NDS, MC,TMR, breathing patterns	Within 5 years	1. Read books and articles on psychosocial interventions, including *The Way of Quigong* – Kenneth Cohen 2. Analyze outcomes after incorporating breathing pattern interventions and adjust practice 3. Collect patient outcomes, analyze outcomes, reflect 4. Discuss outcomes and knowledge with peers and colleagues 5. Attend NDS Solutions workshop for Upper and Lower Quarter 1
Research	1. Study reliability and validity of the V Sit-and-reach 2. Validate new perceived tightness scale 3. Survey research pertaining to practices of athletic trainers in treating and assessing apparent hamstring tightness 4. Investigate use of Mulligan Traction Straight Leg Raise for improving range of motion in patients with apparent hamstring tightness. 5. Review more journal articles for various publications	Within 5 years	1. Receive publication acceptance for articles in each project area 2. Complete projects (peer accountability) 3. Receive a number of invitations to review articles based on research expertise
Education	1. Attend National Athletic Trainer's Association Educator's Conference 2017 2. Read and listen to books and scientific literature on pedagogy 3. Read scientific literature on clinical pedagogy in related healthcare professions 4. Implement and assess efficacy of new teaching techniques	Ongoing (as long as I am an educator)	1. Attend certain number of conferences 2. Gather and examine results of teaching evaluations 3. Gather feedback from assessments of new techniques 4. Discuss new ideas with peers and colleagues 5. Implement new ideas for more effective pedagogy
Professional Service	1. Present at regional and national conferences 2. Volunteer for NATA 3. Volunteer for CSMA	1. Ongoing 2. After 5 years 3. After 5 years	1. Receive a certain number of speaking engagements 2. Accept a specific position assignment 3. Volunteer for a certain number of hours 4. Publish materials through peer collaboration

Justification for Plan of Advanced Practice

My purpose for writing this plan of advanced practice has been to achieve a higher level of professional practice by reflecting on my journey into the profession, assessing my knowledge in the profession, developing specific areas of advanced practice, examining my strengths and weaknesses, and outlining a plan for maturation in the field. I have achieved my purpose and have gained valuable information about my own practice and about areas I can improve on during my daily clinical interactions. Completing this project has aided me in identifying my strengths and weaknesses and has given me renewed vigor for accomplishing and completing my professional goals.

The specific goals I have set to help me to achieve my career goal of becoming an effective advanced-practice AT and educator are achievable and measurable. I plan to pursue these goals through my role as clinician, researcher, and educator within the profession of athletic training. Teaching my students better athletic training practices will help me to impact a larger group of patients vicariously. In this way, I will evoke change within the profession. I will know that I am being a successful leader by judging the clinical, academic and character growth of my students, and by evaluating the feedback I obtain from patients, colleagues and other professionals regarding my efficacy as a leader. As I progress in my unique role as an educator in athletic training, my goals will naturally evolve; therefore, I will continually evaluate and adjust my plan to meet these goals. I will evaluate my progress based on how I have met each specific goal that I have listed in this PoAP and will use the methods of assessment that I have outlined. I am honored and excited to be an ambassador of the DAT program, and I look forward to developing as an AT and serving as a leader in the profession for many years to come.

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CHAPTER 3

OUTCOME SUMMARY, RESIDENCY FINDINGS, AND IMPACT

The purpose of this chapter is to summarize my development in the Doctor of Athletic Training (DAT) program in the areas of patient-reported outcome measures (PROMs), action research (AR), and clinical efficacy. When coupled with analysis of PROMs data, the reflection on my patient-care philosophy, which is contained in this chapter, will highlight my clinical decision-making processes and my implementation of Evidence-Based Practice (EBP) within my clinical practice. The four components of my PROMs analysis include the following: 1) an introduction to my approach to self-directed learning and reflection; 2) chronological evidence of my clinical development; 3) a summary of my impact on the clinical residency sites where I worked; and 4) a conclusion of my development as an advanced practitioner over the past two years.

Introduction: Approach to Self-Directed Learning and Reflection

Self-directed learning is integral to the development of athletic trainers in the clinical setting (Pitney, 1998). The best environment for athletic trainers to learn in is their own workplace. Here, they can establish goals, implement and record specific treatment strategies, and assess whether or not they are learning new principles and paradigms (Pitney, 1998). The self-directed learning approach fits into the framework of EBP, wherein the learner reflects on problems that are specific to his or her clinic in an effort to find solutions to those problems. Arguably, the most important piece of transformative learning is reflection (Pitney, 1998; Williams, 2001). Throughout the DAT program, I was tasked with reflecting on my clinical practice. I accomplished this endeavor through journaling about patient cases and collecting and analyzing PROMs. The act of journaling taught me to be more open and honest in my writing, which helped me to recognize my weaknesses and strengths in my approach to patient care. Coupling reflective journaling with PROMs collection and analysis each semester helped me to recognize trends, learn about the efficacy of my treatments, and set goals for future growth as a clinician.

Chronological Evidence of Clinical Development

Summer 2014 Semester

My journey as an advanced practitioner began in the summer of 2014. Although there was no residency or direct patient care involved in this semester, the principles I learned at this time were integral in my journey to improved patient care. The two most influential concepts in the reformation of my patient care philosophy during the summer semester were regional interdependence (RI), which I discovered by using the Selective Functional Movement Assessment (SFMA), and the Mulligan Concept (MC).

After being exposed to the SFMA and RI through Gray Cook's work, I realized that I was often treating the location of pain rather than the source of it (Cook, 2010). Prior to entering the DAT program, my approach to patient evaluation involved using the traditional History, Observation, Palpation, and Special Tests (HOPS) method. I would typically evaluate a patient, register a diagnosis, and then select a modality, a stretch, and several therapeutic exercises to treat the location of the patient's pain. Instead of looking for the source of pain, I was simply covering up the symptoms, temporarily. After realizing that something simple, such as retraining core rolling patterns, could fix a dysfunction such as a lack of range of motion (ROM) in a patient's hip, I realized that my patient care could drastically improve if I were to look for dysfunction more globally (outside of a patient's site of pain).

While the SFMA taught me about the concept of RI, the MC reformed my approach to patient care by teaching me that healing did not always need to take a long time. For my clinical practice, the MC was not just an extra "tool" in the "toolbox"; it was a catalyst for reforming my philosophical approach to healing and patient care. I wrote the following in a reflection at the end of the semester:

> *My classmates and the instructors told me that they have had instant reduction of pain and increased ROM with this technique* (MC) *after an acute sprain. The results are so surprising because it made me stop and re-think about a concept that I thought was just basic knowledge.*

> *Like most of the athletic training world, I knew that the ankle is sprained and causes pain because the ligaments are stretched or torn, causing both pain and edema formation. This was one of the first pieces of knowledge I can remember learning in my athletic training education and I have been teaching this ever since. However, the Mulligan technique challenged my knowledge by producing instant reduction of pain on an acute injury. I realized that the pain and swelling could be due to a positional fault instead of a ligament sprain, which is shocking. This led me to realize that I should be using treatment techniques like MWMs to help me conceptualize etiology for a variety of conditions. What if knowledge that I thought was common for other conditions could also be altered based on an instant result with a technique?*

As my first semester came to a close, I felt a renewed sense of passion for patient care and for implementing new techniques into my practice; but I also felt intimidated at the prospect of turning my knowledge into practice. I realized that I would need to carefully plan and organize my patient care and collection of PROMs to progress as an advanced practitioner. Therefore, I created goals for the upcoming semester that were based on the concepts of EBP, AR/translational research, and PROMs.

Goals for Fall 2014

Evidence-based practice is a process by which health care providers and students use recent scientific research to evaluate and inform clinical practice and to optimize patient care. A model developed by Dr. Robert Hayward, called the evidence-based information cycle, breaks down the process of practicing the EBP into five steps: assess, ask, acquire, appraise, and apply (Hurley, Denegar, & Hertel, 2010). After reading Hurley's chapters on EBP, my previous views about how it should be incorporated into the clinic changed, drastically. Primarily, I recognized my need for systematic assessment to identify weaknesses in my clinical practice. Prior to my enrollment in the DAT program, I would treat my patients in the same way, again and again, and would tell them, "Healing takes time." What I did not realize, at the time, was that I was just making an excuse for my incompetence at relieving their pain and improving their quality of life. During my first semester of residency in the DAT program, I identified a need for continual reflection and assessment. However, it was not until I began to read about translational science and practice-based evidence (PBE) that I began to grasp how to implement the concepts of reflection and assessment into my own practice.

Translational science is defined as, “a bidirectional flow of discovery, from the clinical setting to the laboratory setting and vice versa” (Mattacola, 2010). As a component of translational science, *practice-based evidence* is the generation of evidence from the clinical setting to the laboratory setting. There are many types of research available to athletic trainers. In the past, ATs have been focused on obtaining information from other sources to inform their own clinical practices; now, clinicians are encouraged to take part in the research process and to generate PBE in the clinic by collecting PROMs. This practice can help ATs to understand which treatments are perceived by patients as “effective.” Ultimately, using clinical research to inform laboratory-based research (and vice versa) will lead to better treatment and patient care (Mattacola, 2010).

Reading about PBE in the editorial by Mattacola challenged my prior conception of research, in that it reinforced the idea that we need both laboratory research and clinical research to advance the profession of athletic training. The concept of translational research was the catalyst for helping me to see that the roles of clinician, researcher, and teacher are actually one. For example, to be an effective clinician, one must be an effective teacher and researcher. At this point, I was ready to apply the concept of translational research, but I was still lacking one key component of the concept: the practice of collecting, analyzing, and assessing PROMs in my clinical practice.

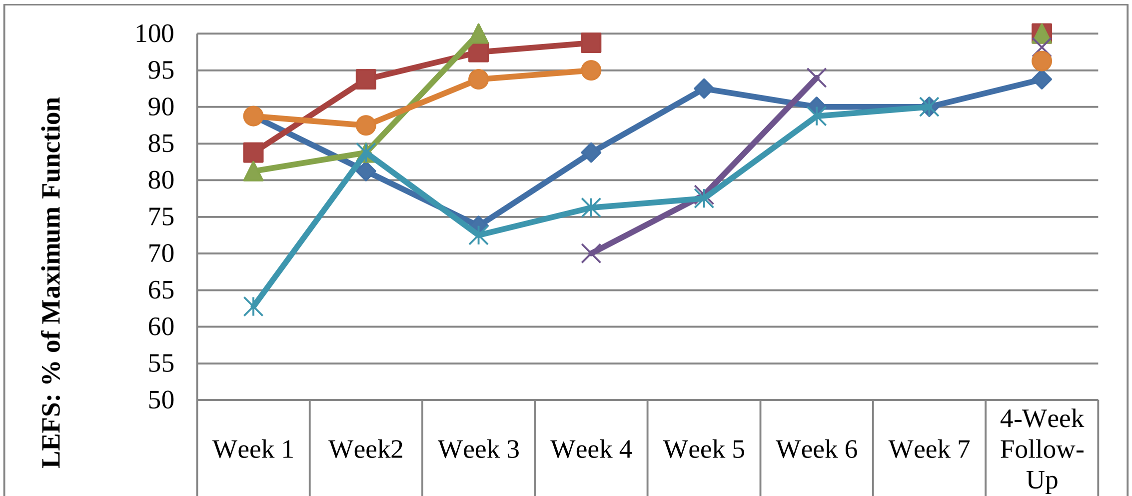
In clinical research, an emphasis should be placed on obtaining PROMs, which are usually self-reported by the patient at various times during the healing process (Valier, Jennings, Parsons, & Vela, 2014). Patient-reported outcomes measures help clinicians to provide optimal care, because they focus primarily on the patient’s well-being and how the patient is responding to his or her injury and rehabilitation (Valier et al., 2014). Contrary to clinician-oriented measures, such as ROM and girth, PROMs assess how the patient responds and feels during recovery. Some PROMs are related to a specific area of the body, while others are global outcome measures that are used to assess the psychological or functional well-being of the patient (Hurley et al., 2010). It is important for the clinician to incorporate local and global measures that pertain to the patient’s condition if the clinician is to effectively evaluate the treatment intervention, and track the overall well-being of the patient. I discovered that collecting patient outcomes helps drive translational research, creating an environment in the clinic that is reflective and that results in improved clinical care and patient well-being. I also realized that I was ready to begin practicing the principles in residency.

I made three goals for myself before entering the first semester of residency. These included: 1) learn about AR through thoughtful reflection, implement PROMs, and analyze problems that become apparent as a result of the data; 2) begin studying in my area of advanced practice by identifying a subset of my clinic's population who suffer from lower extremity chronic injury; and 3) treat MTSS patients *a priori*, using Positional Release Therapy (PRT) and Neurodynamic Sliders (NDS). My successes and struggles with accomplishing these goals are discussed in the following section.

Fall 2014 Semester

Over the course of the Fall 2014 semester, I collected PROMs on nine patients. Six of the patients were assessed using the lower extremity functional scale (LEFS) to determine their functionality as a percent of maximum function. The LEFS is a PROM that assesses the overall well-being and functionality of patients with lower extremity injuries (Binkley, Stratford, Lott, & Riddle, 1999). All six of my patients with lower extremity chronic pain reported at least 90% functionality by Week Seven of treatment (Figure 3.1). Four of my six patients reported at least 90% functionality after only two weeks of treatment. Patient 101 had been treated for four weeks prior to taking the LEFS score, meaning that the patient was actually in his fifth week of treatment when the first LEFS score was taken; therefore, these data may need to be interpreted with caution. While the results I obtained were promising, I knew I could improve on my techniques, reflection, and administration of PROMs, since it still took several of my patients eight weeks to see clinically significant improvements (Figure 3.1).

Figure 3.1: Weekly LEFS Scores For All Lower Extremity Patients



	Week 1	Week2	Week 3	Week 4	Week 5	Week 6	Week 7	4-Week Follow-Up
Pt. 101	88.75	81.25	73.75	83.75	92.5	90	90	93.75
Pt. 102	83.75	93.75	97.5	98.75				100
Pt. 103	81.25	83.75	100					100
Pt. 104				70	78	94		98.125
Pt. 105	62.75	83.75	72.5	76.25	77.5	88.75	90	
Pt. 106	88.75	87.5	93.75	95				96.25

*Pt. = Patient; LEFS = Lower Extremity Functional Scale

Medial Tibial Stress Syndrome Patients

One of my goals for the Fall 2014 semester was to perform an *a priori* study on patients with Medial Tibial Stress Syndrome (MTSS). I decided to study MTSS because it was a local problem that I had identified in my clinical practice and because very few prospective studies on MTSS treatment interventions have been performed. Of those studies, the average time that it took for a patient to fully complete a running progression program was 60-117 days (Moen et al., 2012; Rompe, Cacchio, Furia, & Maffulli, 2010). Therefore, I planned to use my newfound knowledge of EBP, PBE, and AR to improve my patients' recovery from MTSS.

During the Fall 2014 semester, my primary approach to patients with MTSS utilized the Myokinesthetics (MYK) system, which is an evaluation and treatment concept based on principles of neurology and postural balance (Brody, Baker, Nasypany, & May, 2015). The theory behind MYK is that a clinician can create a central nervous system (CNS) change by systematically stimulating the afferent and efferent neural pathways for each nerve root (Brody et al., 2015). By stimulating the muscles along a nerve root, the CNS then corrects poor motor habits in other areas of the body, resulting in a restoration of postural balance. When postural balance is restored, pain is reduced, because muscles and joints are functioning properly. Michael Uriate, who developed the MYK system (Uriate, n.d.), highlighted several patients in his workshop who had suffered from MTSS and who improved significantly from MYK treatment; therefore, I decided that I would implement MYK in my clinical practice during the Fall 2014 semester.

As I began to treat patients, I struggled with the concept of AR and when/how often to change my treatment if it was not working. My struggle is readily apparent in one of my journal entries from that time:

> *. . . I have been so inundated with the typical quantitative research project design* [sic], *trying to observe correlations with high internal validity. As I begin to observe and reflect on my area of advanced practice, which will hopefully be lower extremity chronic muscle injury, I find that my data collection and patient outcomes are influenced by a variety of factors that are outside of my control. For example, I began to collect data on two MTSS patients this past week and have used MYK as an evaluation and treatment technique. I am wondering if the patient is/should* [sic] *continue with her pre-race ritual which involves some warm-up and stretching, because that may confound the effects of the MYK treatment. But, according to this action research paradigm, I guess those pre-race rituals are OK, because I am looking at this as a more practical clinical case study with high external validity instead of high internal validity. It feels so weird to me, but I guess I need to stop looking at the study as "The Effect of ____ on ___" and start looking at it more holistically. Also, if I am not seeing results with MYK for 1, 2, 3 or more weeks, should I switch my treatment to a different one and continue to chart outcomes? From what I understand, I think the answer is "yes, but have a reason for which treatment you choose next based on what you have discovered already."*

After writing this journal entry, I made up my mind that I needed to try a variety of treatments until I found one that worked. My first patient in the fall of 2014 was a male soccer player who had struggled with MTSS pain (5/10 on the Numeric Pain Rating Scale, or NPRS) for over a year prior to my evaluation of him. He had tried custom orthotics, ice massage, and stretching, none of which did anything to improve his pain. His pain was increased with toe-off and ambulation. Tuning fork, bump, and Potts's special tests were performed to rule out a stress fracture as a differential diagnosis. After performing the initial evaluation, I did not know where to start. To give myself time to think, I handed my patient ice and told him to come back the next day. On Day Two, I administered the Disablement of the Physically Active (DPA) Scale and the Numeric Pain Rating Scale (NPRS), and decided to use Total Motion Release (TMR) Fabulous 6 to evaluate and treat asymmetries. After treating his asymmetries with TMR, the patient experienced no immediate reduction in pain. On Day Three, I evaluated pelvic asymmetries. I then attempted to treat the apparent innominate rotation using the muscle energy technique and foam rolling of the Iliotibial Band. After seeing no immediate improvements in the pelvic asymmetries, I fitted the patient with a lateral heel wedge and evaluated him using the SFMA. On Day Four, I treated the patient with PRT and light massage of the fascia. The patient reported his pain as "decreased," to a 2/10 on the NPRS. However, his normal pain (5/10) returned as soon as he resumed activity. At the end of the semester, I analyzed this patient case through a time-sensitive journal reflection:

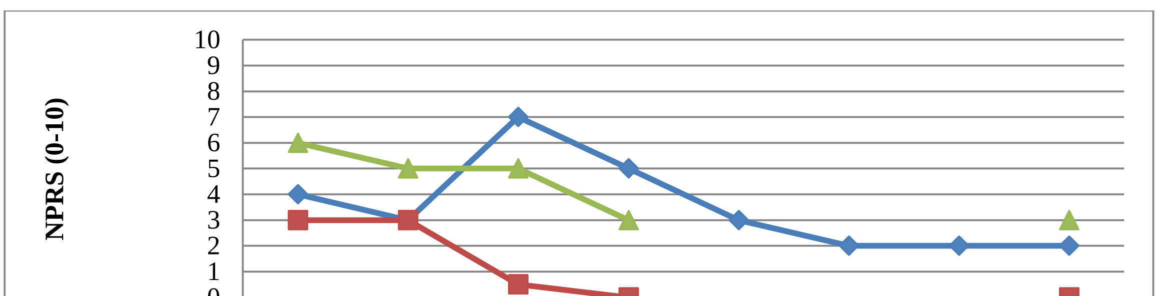
> *Sadly, the patient that I was working with was getting frustrated with not having a definitive answer for his pain, and so was I. I did not administer outcomes regularly on this patient (although I provided the initial DPA [sic] Scale, I did not keep track of* [sic] *when I administered it). Also, as Robin brought up in her comment, I was fleeting around between the paradigms I administered instead of sticking with one for a few days. In my inexperience, I did not practice getting better at each technique, but instead tried each one once and then gave up when they did not produce instant results.*

In retrospect, I realize that I knew very little about the proper implementation of almost all the techniques I had tried. For example, I did not use TMR to its fullest potential during this iinitial visit because I did not instruct the patient on the proper trunk twisting technique and failed to incorporate TMR evaluation and treatment forms. Additionally I learned that I needed to more consistently implement PROMs on a weekly basis. Although my first patient case was a struggle, it drove me to learn more about the techniques that I did not know well, and helped me develop a better approach to collecting PROMs in future patient encounters.

I collected PROMs on three additional patients with MTSS over the course of the semester. I then compared my results with the literature to see how my patients were progressing compared to what others had reported. When comparing the length of treatment required for improvements, my patients were discharged after an average of 30 days compared to the average of 60-117 days reported in the literature (Moen et al., 2012; Rompe et al., 2010). However, it is difficult to compare my patient outcomes directly to other studies, because I only collected outcomes on three patients in the Fall 2014 semester for MTSS. My primary method of treatment for MTSS was the MYK system; however, I altered my treatment methods throughout the semester based on the patient's progress and reported symptoms.

For example, during Week 3 of treatment, Patient 101 reported a worsening in symptoms (Figures 3.2, 3.3). I discontinued MYK and began to treat various dysfunctions identified during the SFMA evaluation. I did not, however, take detailed enough notes to know when I switched from one treatment to another or what treatments I applied on which day. At the end of the semester I realized that I needed to study and practice new paradigms I was using and apply each paradigm with more consistency. Switching paradigms constantly made it difficult to reflect on my practice and make plans for its improvement.

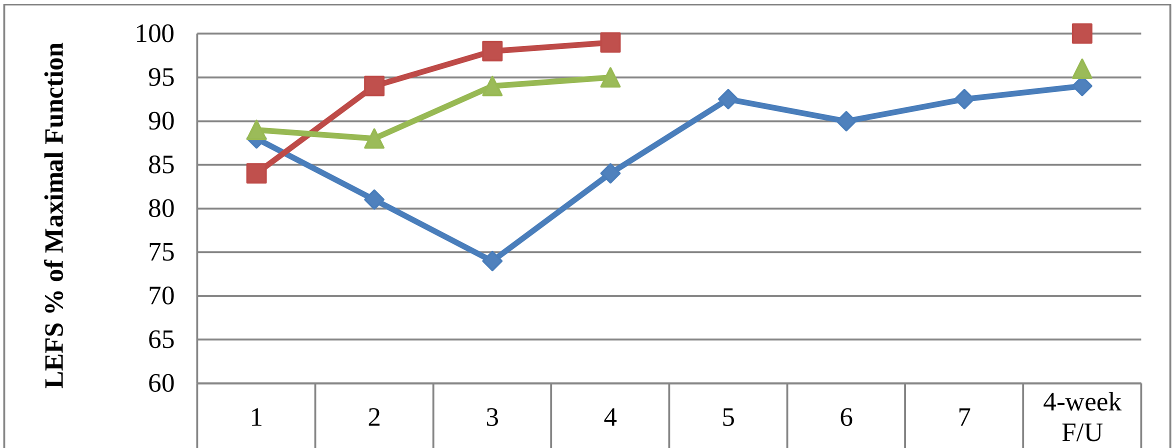
Figure 3.2: Weekly Reported NPRS "Worst" – MTSS Patients



	1	2	3	4	5	6	7	4-week F/U
Patient 101	4	3	7	5	3	2	2	2
Patient 102	3	3	0.5	0				0
Patient 106	6	5	5	3				3

*NPRS = Numeric Pain Rating Scale; MTSS = Medial Tibial Stress Syndrome; F/U = Follow-up; Pt. = Patient

Figure 3.3: Weekly Reported LEFS – MTSS patients



	1	2	3	4	5	6	7	4-week F/U
Pt 101	88	81	74	84	92.5	90	92.5	94
Pt 102	84	94	98	99				100
Pt 106	89	88	94	95				96

*LEFS – Lower Extremity Functional Scale; MTSS = Medial Tibial Stress Syndrome; F/U = Follow-up; Pt. = Patient

Patellar Tendinopathy Patients

The next local problem I identified in the fall of 2014 was patellar tendinopathy. Rehabilitation of patellar tendinopathies can take anywhere from 3-12 months (Khan, Cook, Purdam, & University of British Columbia, 2001; Kountouris & Cook, 2007). For example, Young, Cook, Purdam, Kiss, and Alfredson (2005) demonstrated that volleyball players who suffered from patellar tendinopathy did not improve after eight weeks of rest. Although many treatment methods exist for patellar tendinopathy, there is little evidence to support one effective treatment method for reducing pain and dysfunction. Eccentric exercises seem to be the most effective known treatment method for reducing the pain and dysfunction related to tendinopathy (Kountouris & Cook, 2007).

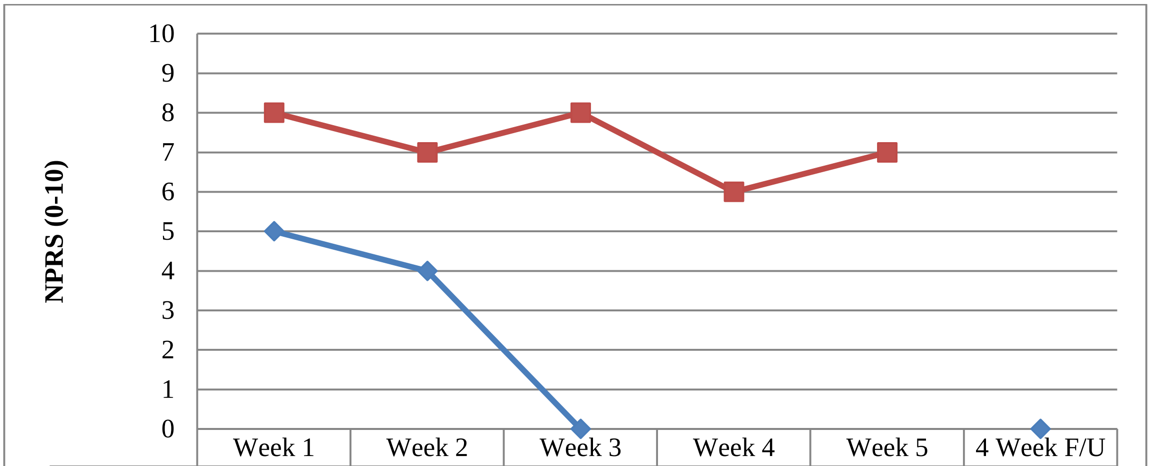
I was not confident in my skills with the new paradigms like TMR, MC, and the SFMA so instead of trying them out, I decided to stick with my familiar paradigms and test them to see how effective they were in treating common patellar tendinopathy. Therefore, my patients received both closed-chain and open-chain eccentric exercises for the quadriceps muscles, in addition to soft-tissue mobilization for the patellar tendon.

Patient 103 was discharged after three weeks of treatment, reporting 0/10 pain ("usually") on the NPRS and a score of 100% on the LEFS (Figures 3.4, 3.5). After a four-week follow-up, the patient also reported a 0/10 on the NPRS and a score of 100% on the LEFS. At first, I was proud of my PROMs; but on reflection, I believe that I just happened to choose exactly what he needed without much clinical thought or reasoning behind the choice I had made. I performed a poor evaluation of the patient and did not categorize him based on how I thought he would respond to treatment.

In contrast to Patient 103, Patient 105 did not improve after six weeks of eccentric training and soft tissue mobilization. At the end of the semester, Patient 105 reported a 1/10 ("usually") on the NPRS and a score of 90% on the LEFS; however the patient still reported a "worst" pain of 7/10 at discharge (Figures 3.4, 3.5). Instead of reevaluating the patient or trying a different treatment, I continued to try the same treatment because I was afraid of reverting back to my first, "shotgun" approach, in which I had quickly changed from one treatment to another and to another. Also, I did not know how to properly evaluate and classify my patients. I did not know what to do, so I did nothing. Becoming paralyze by overanalyzing a situation is something that I have often struggled with and would improve upon in my future clinical practice.

I took away two main lessons from treating Patient 103 and Patient 105: 1) What works for one patient may not necessarily work well for another patient; and 2) I must overcome my "paralysis by analysis." As I thought about how both patients responded differently to the same treatment, I wondered if applying quick treatments during the evaluation process could help me to determine which treatment would improve a patient's outcomes and help guide his or her rehabilitation program. This marked the beginning of my investigation of treatment-based classification (TBC) (I did not fully form my thoughts on this concept until about a year later). Additionally, I noted that there was still room for improvement in my treatment of patellar tendinopathy. As the Fall 2014 semester drew to a close, I resolved to assess and compare techniques that address patellar tendinopathy from a RI approach and to compare the PROMs to my Fall 2014 patients.

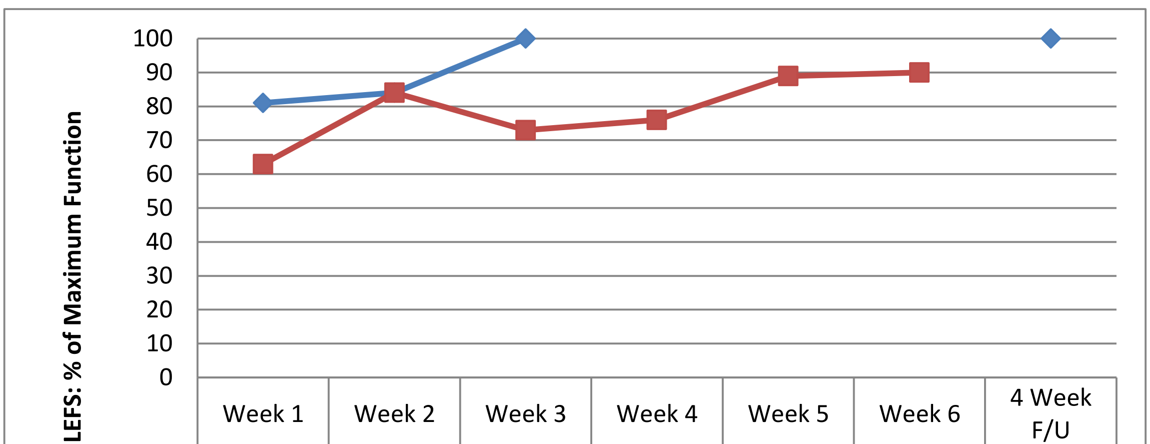
Figure 3.4: Weekly Reported NPRS "Worst" – Patellar Tendinopathy Pts.



	Week 1	Week 2	Week 3	Week 4	Week 5	4 Week F/U
Pt. 103	5	4	0			0
Pt. 105	8	7	8	6	7	

*NPRS = Numeric Pain Rating Scale; MTSS = Medial Tibial Stress Syndrome; F/U = Follow-up; Pt. = Patient

Figure 3.5: Weekly Reported LEFS – Patellar Tendinopathy Pts.



	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	4 Week F/U
Pt. 103	81	84	100				100
Pt. 105	63	84	73	76	89	90	

*LEFS = Lower Extremity Functional Scale; MTSS = Medial Tibial Stress Syndrome; F/U = Follow-up; Pt. = Patient

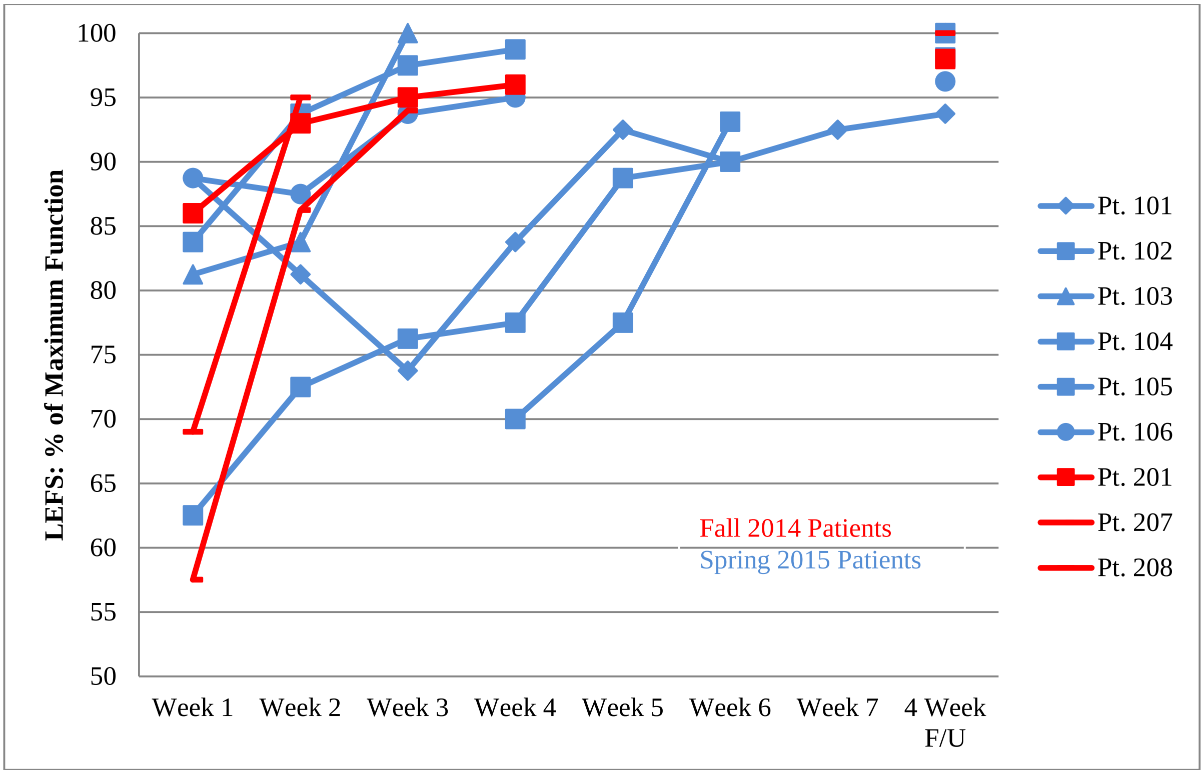
Goals for Spring 2015

After finishing my first semester of residency in the DAT, I was frustrated with my clinical practice; however, I had, at least, acknowledged my shortcomings and identified strategies for improvement. I had collected consistent PROMs and follow-up evaluations, which allowed me to be critical of my clinical decisions and my treatment efficacy. Based on my weaknesses, which I identified through analysis of my PROMs, I made several goals for of the Spring 2015 semester: 1) I would take more detailed progress notes for my patients; 2) I would use at least two new outcomes measures in my clinical practice (I had primarily used the LEFS, GRoC, and the NPRS in Fall 2014, and I knew that I needed to branch out to capture more of the psychosocial outcomes through scales like the DPA Scale.); 3) I would plan out a case study, *a priori* (When I began the case-study assignment in Fall 2014, I thought I knew what an *a priori* case study would involve. However, after beginning to write my study, I realized that my collection of PROMs and tracking of my patients' rehabilitation at the beginning of the study was inconsistent, and my plan for evaluating and rehabilitating my patient was not premeditated.); and 4) I would be more steadfast in practicing a single treatment.

Spring 2015 Semester

Over the course of the spring semester, I collected PROMs on 16 new patients. Of those 16 patients, 3 patients fell into the category of "lower extremity chronic injury." Between Fall 2014 and Spring 2015, I collected PROMs on nine total patients with lower extremity chronic injury. Five of these patients were diagnosed with MTSS, three were diagnosed with patellar tendinopathy, and one was diagnosed with Iliotibial Band Syndrome (ITBS). By analyzing the LEFS scores of all chronic lower extremity pain patients, I can reflect on the efficacy of my overall treatment of chronic lower extremity muscular pain pathologies and can compare my treatment efficacy from the Fall 2014 semester to the Spring 2015 semester. When comparing the trends in the data from Fall 2014 (Pt. 101-106) to Spring 2015 (Pt. 201, 207, 208), it is evident that the treatment duration was significantly shorter during the spring semester. Generally, there is a sharp, upward trend in the data for patients I treated during the Spring 2015 semester, compared to Fall 2014. In order to identify what practices may have contributed to the improvement in my patients' outcomes, I will reflect on the changes I made in my clinical practice during the Spring 2014 semester in the following sections.

Figure 3.6: LEFS Scores For All Lower Extremity Patients



*Pt. = Patient; LEFS = Lower Extremity Functional Scale

MTSS Patients

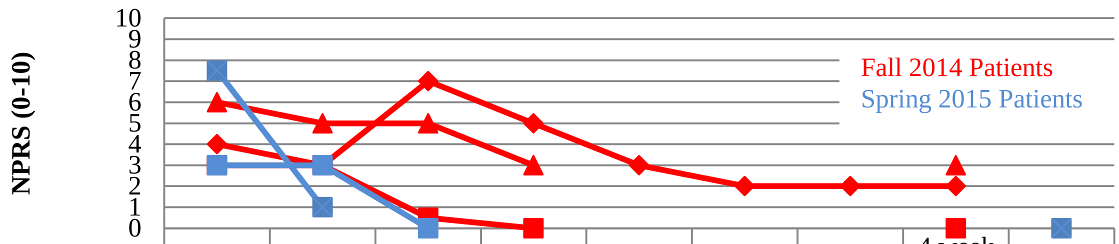
In the spring semester of 2015, I changed my approach to MTSS by researching the problem in greater detail in my local practice and in the literature. First, I researched MTSS in more depth by reading the literature on treatments and etiology. Medial Tibial Stress Syndrome is commonly thought to be a periostitis of the distal medial tibia due to traction forces of the muscle origins; however, researchers have proposed that MTSS may actually be a tightness or distortion of the deep crural fascia (Bennett et al., 2001; Fogarty, n.d.; Levick, 2004a; Schulze, Finze, Bader, & Lison, 2014; Stickley, Hetzler, Kimura, & Lozanoff, 2009). After learning about MTSS in more depth from the literature and my clinical practice in the fall of 2014, I resolved to approach my patients' pain by incorporating an evaluation that considers factors outside of the location of pain. Additionally, I aimed to improve my care of MTSS patients by taking more detailed notes on their progression and staying with a single treatment/approach for a longer period of time. In Spring 2015, I treated two patients whom I diagnosed with MTSS using my reformed approach to MTSS. Both of these patients returned to play in their respective sports in an average of 1.5 weeks (Figures 3.7, 3.8).

To highlight my clinical growth in treating patients with MTSS, I will explain my clinical reasoning and my decision-making process for a patient with MTSS whom I treated during the Spring 2015 semester. Patient 207 was a male volleyball player who was evaluated by a colleague in the clinic while I was away, traveling with another team. My colleague's initial diagnosis was a stress fracture, so the patient was placed in a walking boot and was restricted from all activity. Three days after the initial evaluation by my colleague, while waiting on the results from the bone scan and x-ray, I began working with the patient using NDS sciatic sliders and PRT for a tender point on the medial head of the gastrocnemius. When we saw the results, four days later (one week after initial evaluation), both the x-ray and bone scan were negative; therefore the patient was cleared for activity. After four days of PRT and NDS treatments, the patient's pain had not decreased from a 5/10 at rest. At this point, I was fairly confident that PRT for the gastrocnemius tender point and NDS sciatic sliders were not going to alleviate this patient's pain, so I decided to reevaluate the patient more using the SFMA. During the evaluation, I identified a shoulder girdle Stability Motor Control Dysfunction (SMCD) and non-uniform thoracic curve during multi-segmental flexion. Base on these findings, I developed the following protocol to address movement dysfunctions: Sacrum Mobilizations (strain-counter): 3x; PRT for Hip Trigger Points: 60-90 sec; Thoracic SNAGS: 3x; Lumbar Traction: 3x; Hip Flexion MWM: 3x10; TMR Straight Arm Raise Active Opposite: 3x 10. The patient rated his pain 7/10 on the Numeric Pain Rating Scale (NPRS) pre-treatment, and 4/10 post-treatment. We continued the rehabilitation program for the next two days, and the patient continued to participate in volleyball practices and games. His pain decreased to a 1/10 on the NPRS at rest. Two weeks after the date of the initial injury, the patient reported 0/10 pain on the NPRS and 94% on the LEFS. Through this patient case, I learned that approaching an injury from an RI perspective allowed me to more effectively treat the patient with an individualized rehabilitation program. I also became more confident in my ability to treat patients, and resolved to try to discover the cause of my patients' pain through a RI approach before simply referring them to the physician. A time-sensitive, narrative journal entry entitled, "Doctor, Doctor, Give Me the News," highlights my growth in thinking through this patient case:

> *This case has taught me to be patient and thorough with non-emergency conditions that may or may not warrant physician referral. Ideally, in the future I would like to take these types of patients through treatment-based evaluations and the full SFMA before making a judgment call to refer for unnecessary, expensive diagnostics.*

When I compared the PROMs from my Fall 2014 MTSS patients with the PROMs from my Spring 2015 MTSS patients, it was evident that the latter group improved faster than the former (Figures 3.7, 3.8). The most important concept that was reinforced through treating patients with MTSS during the Spring 2015 semester is that not every patient will respond to the same treatment in the same way. Two patients who are diagnosed with MTSS may have two completely different underlying etiological factors that contribute to or exacerbate their pain. I learned that it is my duty as a clinician to identify and classify patients based on how they respond to a variety of quick treatments, such as NDS and PRT. Thus, I made it my goal to continue trying different combinations of treatments in order to determine which category of patients responded to which treatments. Specifically, I resolved to try a treatment to address apparent restrictions or referred pain from the deep crural fascia.

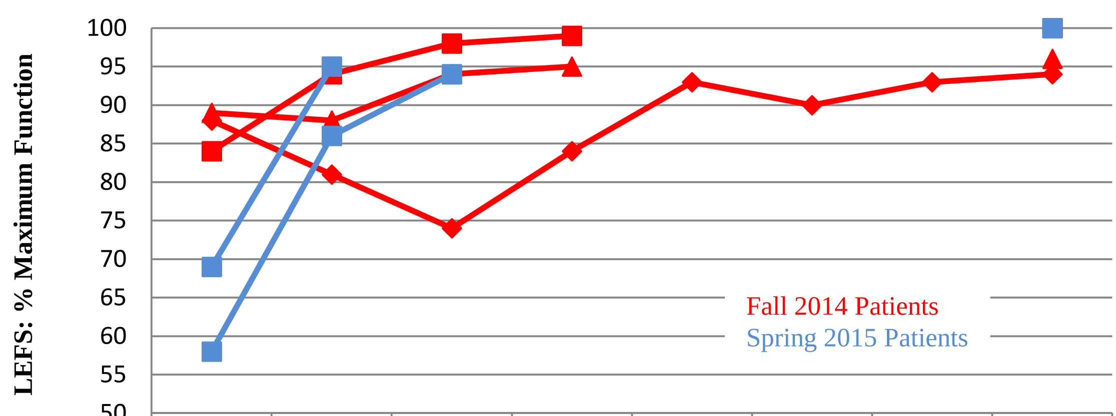
Figure 3.7: Weekly Reported NPRS – MTSS Patients



	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	4 week F/U	
Pt. 101	4	3	7	5	3	2	2	2	
Pt. 102	3	3	0.5	0				0	
Pt. 106	6	5	5	3				3	
Pt. 207	7.5	1							0
Pt. 208	3	3	0						

*NPRS = Numeric Pain Rating Scale; MTSS = Medial Tibial Stress Syndrome; F/U = Follow-up; Pt. = Patient
**For Fall 2014 patients' "Worst" Pain; For Spring 2015 patients' Pain "During Activity"

Figure 3.8: Weekly Reported LEFS – MTSS Patients



	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	4 week F/U
Pt. 101	88	81	74	84	93	90	93	94
Pt. 102	84	94	98	99				100
Pt. 106	89	88	94	95				96
Pt. 207	69	95						100
Pt. 208	58	86	94					

*LEFS = Lower Extremity Functional Scale; MTSS = Medial Tibial Stress Syndrome; F/U = Follow-up; Pt. = Patient

Patellar Tendinopathy Patients

During the Spring 2015 semester, I reformed my approach to treating patients with patellar tendinopathy. The previous fall, I had addressed both of my tendinopathy patients from the same approach, using a standardized program consisting of eccentric exercises and massage. After reflecting on my varied outcomes from Fall 2014, I began to question my approach to standardized rehabilitation. I realized that I was not going to grow as a clinician if I only used techniques that were supported by the literature. If I only used those techniques, that would limit my clinical decision-making opportunities and would not allow me to try new techniques based on individual patient needs. Thus, as I began to collect PROMs on patellar tendinopathy patients in the spring, I resolved to use a more individualized approach to treat my patients.

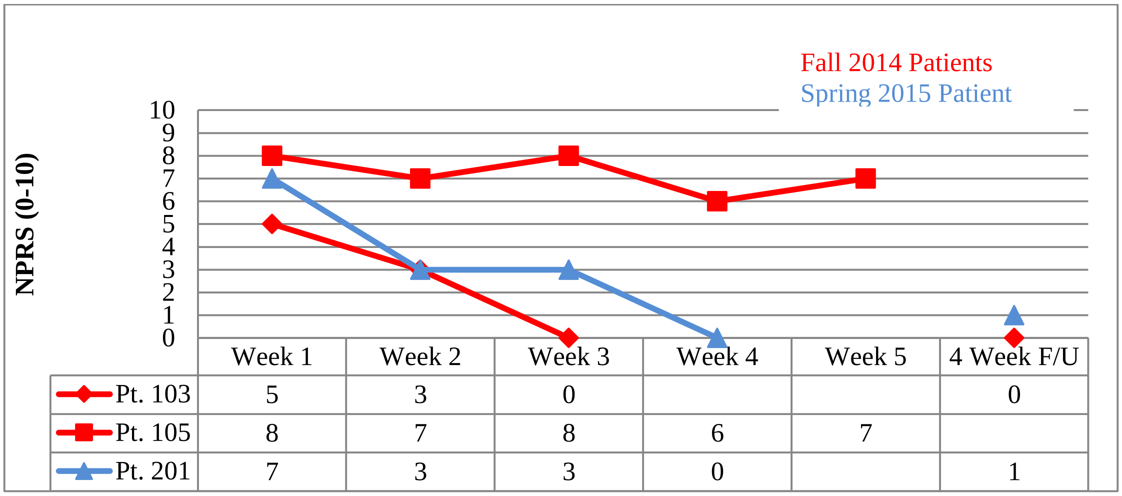
A portion of a time-sensitive journal entry that I wrote, entitled, “Patellar Tendinopathy Patient Part 3: ’Round and ’round the rehab goes, where it stops, nobody knows,” highlights my thoughts regarding the treatment of a particular patient (Patient 201) whom I diagnosed with patellar tendinopathy in the spring semester. The journey entry also shows my rationale for using a global, individualized approach when treating the patient:

> *In a short recap of my last post, I had narrowed down my patient’s movement dysfunctions using the SFMA to primarily: 1. SMCD in shoulder girdle and 2. Lumbar ext/rot JMD/TED. In order to address these issues I began a series of treatments aimed at reducing the movement dysfunctions. His current rehab program is: >Warm-up – Stationary Bike (5 min.) >4-way Restricted Scapular clocks (2 x 10 sc. holds) >TMR Trunk twists (to non-restricted side) (3 x 10) >Mulligan Lumbar Traction (3x) >PRT at hip for quad inhibition (2 points x 90sc-120sc) > E-stim (10 min.)* [This protocol will be further explained, below,]. *Hopefully the rationale behind my decision to include the TMR/Scap clocks/Mulligan/PRT is clear, to address the dysfunctions from the SFMA breakouts. PRT was included as a pain management and quadriceps inhibition technique. Regarding the warm-up/e-stim, this particular patient had insisted on including both because we had used it last year (Ironically, last year we had with no/little success at reducing his pain and he had to sit out a few games and practices because of it).*

At this point in my patient care, I was becoming more aware of my rationale and thought process and was able to give a reason for why I chose to incorporate a technique into my rehabilitation. This was evidence of my growth, not only over the course of three semesters in the DAT program, but since my pre-DAT program days when I had used only standardized rehabilitation programs. Although I had certainly grown from that time to where I was at in my Fall 2015 semester, I would realize, later, that I might have overlooked some psychosocial issues that could have caused Patient 201's pain.

The comparison between my PROMs for patellar tendinopathy patients between semesters revealed that my RI approach, which I had applied during the Spring 2015 semester, improved my patient's PROMs faster than it had improved the PROMs of another patient in the previous semester (Figures 3.9, 3.10). As I stated in my previous semester's reflection, I believe that Patient 103 improved rapidly because the treatment choice may have been appropriate for that patient; however, because I used the same treatment method for Patient 105 with drastically different results, I needed to seek out a better evaluation method—one that involved more critical thinking. As is made evident by Patient 201's PROMs, I improved this patient's well being and decreased his pain significantly in less than four weeks. Although I still wish to improve my patients' symptoms faster, during the Spring 2015 semester, I developed an approach and evaluation for patellar tendinopathy patients that emphasized individualized rehabilitation, which is more effective than simply choosing the same program for every patellar tendinopathy patient who walks into the clinic.

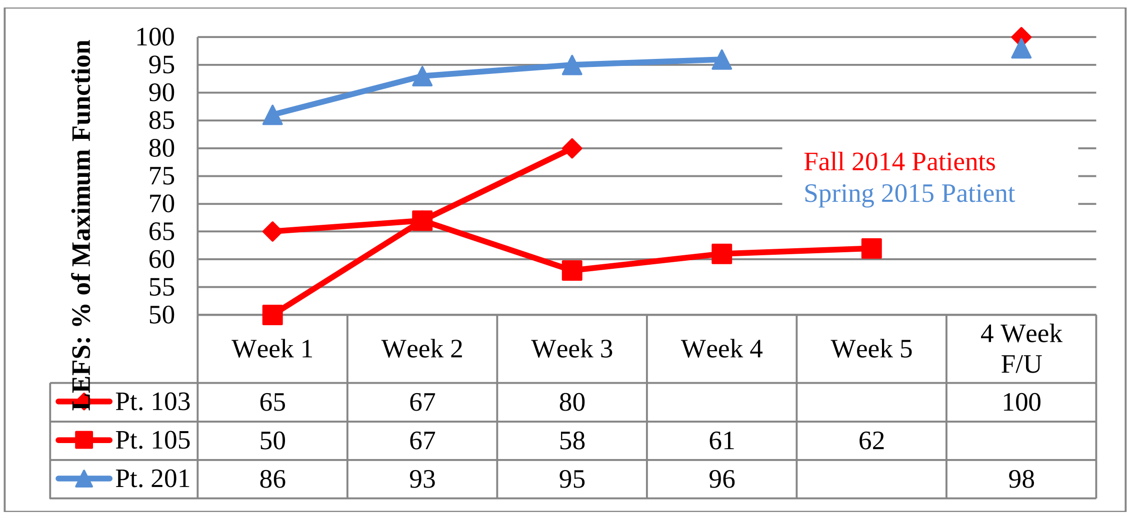
Figure 3.9: Weekly Reported NPRS "Worst" – Patellar Tendinopathy Pts.



	Week 1	Week 2	Week 3	Week 4	Week 5	4 Week F/U
Pt. 103	5	3	0			0
Pt. 105	8	7	8	6	7	
Pt. 201	7	3	3	0		1

*NPRS = Numeric Pain Rating Scale; MTSS = Medial Tibial Stress Syndrome; F/U = Follow-up; Pt. = Patient

Figure 3.10 Weekly Reported LEFS –Patellar Tendinopathy Pts.



	Week 1	Week 2	Week 3	Week 4	Week 5	4 Week F/U
Pt. 103	65	67	80			100
Pt. 105	50	67	58	61	62	
Pt. 201	86	93	95	96		98

*LEFS – Lower Extremity Functional Scale; MTSS = Medial Tibial Stress Syndrome; F/U = Follow-up; Pt. = Patient

ACL Post-Surgery Patient Outcomes

In the Spring 2015 semester, I also collected PROMs on two patients who were post-operative for Anterior Cruciate Ligament (ACL) reconstruction. This taught me how to more effectively utilize PROMs to improve my practice. It is important for clinicians to know how to progress a patient through an ACL protocol effectively, and, as the patient progresses, to aid the patient not only in the physical, but in the psychological aspects of his or her injury (te Wierike, van der Sluis, van den

Akker-Scheek, Elferink-Gemser, & Visscher, 2013). In recent literature, it has been suggested that collecting PROMs on ACL patients during their recovery from surgery may aid future clinicians in creating "norms" for PROMs that they can then use to compare other ACL patients' progress. These norms could potentially aid clinicians in recognizing if their patients are not recovering at a proper rate, or it may aid them in choosing progression of rehabilitation exercises (Cupido, Peterson, Sutherland, Ayeni, & Stratford, 2014). The goal of my outcomes collection for my ACL patients was to generate personal/local "norms" that I could then use to establish a baseline by which I could compare the outcomes of future patients.

Although I could not find a study that used the NPRS to gather outcomes on ACL patients post surgery, I did find a study where the authors measured LEFS scores in ACL patients post surgery on a weekly basis. However, comparing my scores to their scores was difficult, because they did not present a table with their weekly data; rather, they chose to use a graph (Cupido et al., 2014). Therefore, I created a table to compare the approximate data from the "line of best fit" on the researchers' graph to the data from my patient's first seven weeks post operation (Table 3.1).

Table 3.1: Comparison of Lower Extremity Functional Scale Scores for Anterior Cruciate Ligament Post-Surgery Patients to Cupido et al. (2014)

Week	***Bobby's Mean LEFS Outcomes***	***Cupido et al. (2014) Mean LEFS Outcomes***
2 weeks F/U	25	25
3 weeks F/U	35	32
4 weeks F/U	40	39
5 weeks F/U	45	45
6 weeks F/U	46	48
7 weeks F/U	51	52

*LEFS = Lower Extremity Functional Scale; F/U = Follow-up

Table 3.2: ACL Post-Surgery Patients' Global Outcomes Data

*Weeks post-operation***	*Pt. 202 *NPRS worst*	*Pt. 205 NPRS worst*	*Pt. 202 – *LEFS*	*Pt. 205 - LEFS*	*Pt. 202 – *DPA Scale*	*Pt. 205 – DPA Scale*
2	8	8	20%	43%	47	63
3	4	5.5	40%	48%	43	59
4	3	4	50%	50%	45	36
5	2	2	46%	66%	46	38
6	4	2	51%	65%	47	39
7	3	2	58%	69%	38	34

*ACL = Anterior Cruciate Ligament; NPRS = Numeric Pain Rating Scale; DPA = Disablement of the Physically Active
** Due to patient scheduling conflicts, several follow-ups were not taken on the exact date that marked the start of a new week.

After reflecting on the PROMs for my post-operative ACL patients in their first eight weeks of rehabilitation, I was able to generate a "normal" progression for two patients. While this may aid me in progressing future patients, it is worth noting that I did not deviate from the "traditional" rehabilitation protocol during the Spring 2015 semester. I was intimidated to try something new, because I feared that the new techniques would be contraindicated for a post-operative ACL patient. Instead of overcoming my fears, I decided to take the "easy" route with my treatments and see how my patients progressed with a rehabilitation that involved the typical stretching, strengthening, and ROM exercises. When I reflected on that decision, I realized that I could have tried techniques that were not contraindicated to help manage my patients' pain, such as PRT, NDS, TMR, or MC. For future patients, I made it my goal to try these new techniques in order to improve their PROMs.

I also had an epiphany regarding how to use patients' PROMs more actively in the clinic. Instead of simply collecting the PROMs, filing them away, and never looking at them again (like I had done in Fall 2014), I used them actively to generate monthly conversations with my patients about how they were progressing through their rehabilitation and about how they were feeling. I spent time with the two patients, reviewing their graphs and clinical progress, and I showed them these data. Both patients responded positively to these meetings and seemed to enjoy getting to see their progress, visually. At this time, I began to better understand *practically* what I already knew *theoretically*: Collecting outcomes should not be a mindless or tedious task; it should seamlessly integrate with my existing practice and should result in better patient care, improved reflection, and informed clinical decision-making.

Goals for Fall 2015

I finished my second semester in residency feeling like I was on a rollercoaster of successes and failures. Generally speaking, I was improving as a clinician, because I was performing more thorough evaluations from an RI perspective, taking detailed progress notes, improving PROMs, and creating individualized rehabilitation programs. However, I realized that I was struggling with finding a balance between being organized with collecting PROMs and caring for patients on a personal level. During the semester, I had begun to focus on improving my weaknesses from the previous (Fall 2014) semester; but in doing that, I focused too much on improving a few specific tasks. As a result, I missed the overarching goal of outcomes collection and forgot some basics of clinical practice that are important, such as having a relationship with my patients. Therefore, my goals for my DAT residency going into my final (Fall 2015) semester were to find balance in my PROMs collection and improve specific areas of weakness that I had identified while treating patients during the Spring 2015 semester.

First, I made a goal to write in a personal diary at least three times a week. This would aid me in practicing reflection. Second, I made a point to remember to collect clinician-oriented outcome measures, such as ROM and girth, along with my PROMs. Third, I resolved to continue to approach my patient evaluations from an RI perspective and to include more of the psychosocial aspect of treatment and evaluation (specifically for patients with low back pain). Lastly, I made a goal to collect more consistent follow-up evaluations to determine long-term effects of my treatment.

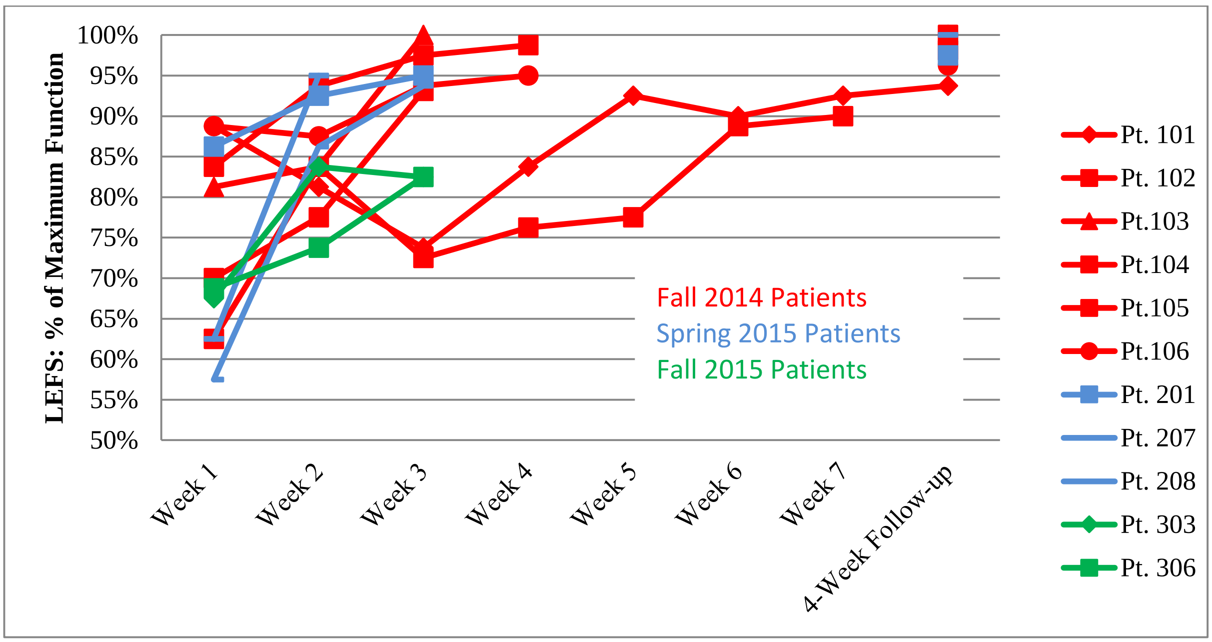
Fall 2015 Semester

In my last semester of DAT program residency, I began a new position at Waynesburg University, where I saw patients strictly on a referral basis. The beginning of the semester was slow for collecting PROMs; however, as the semester progressed, I began to establish my practice and to gain a reputation for healing. Over the course of the semester, I collected weekly PROMs on 12 patients. Unfortunately, I only collected PROMs on two more patients who fell into my area of advanced practice. This meant that over the course of three semesters, I collected outcomes on 11 patients with lower extremity chronic injury (Figure 3.11). Of these patients, seven were diagnosed with MTSS, three were diagnosed with patellar tendinopathy, and one was diagnosed with ITBS. Each semester, the MTSS patients and patellar tendinopathy patients were treated using different techniques, which allowed me to compare the efficacy of the treatments that were used. However, I could not run parametric statistical analyses on my PROMs, because I had a total of 11 patients in this category. Eleven total patients would not achieve a power great enough to detect statistical significance between three groups. This analysis would increase the risk of committing a Type II statistical error (accepting the null hypothesis when the null hypothesis is false) (Vincent & Wier, 2012). Additionally, it is difficult to evaluate patterns and trends with only 11 patients total in one category. Recruiting more patients would allow me to draw on more meaningful data for clinical growth.

During the Fall 2015 semester, my lower extremity chronic pain patients were discharged within three weeks (Figure 3.11) as opposed to within four weeks, which was the average during the previous two semesters. However, both Fall 2015 semester patients were not above 90% at discharge on the LEFS. One reason for this may be that both patients' baseline LEFS scores were lower than patients' scores had been in previous semesters. Another reason could be that both patients were treated with an *a priori* approach to NDS, which may not have been the best technique for the patients. The limitations of the *a priori* study will be discussed in greater detail later in this section.

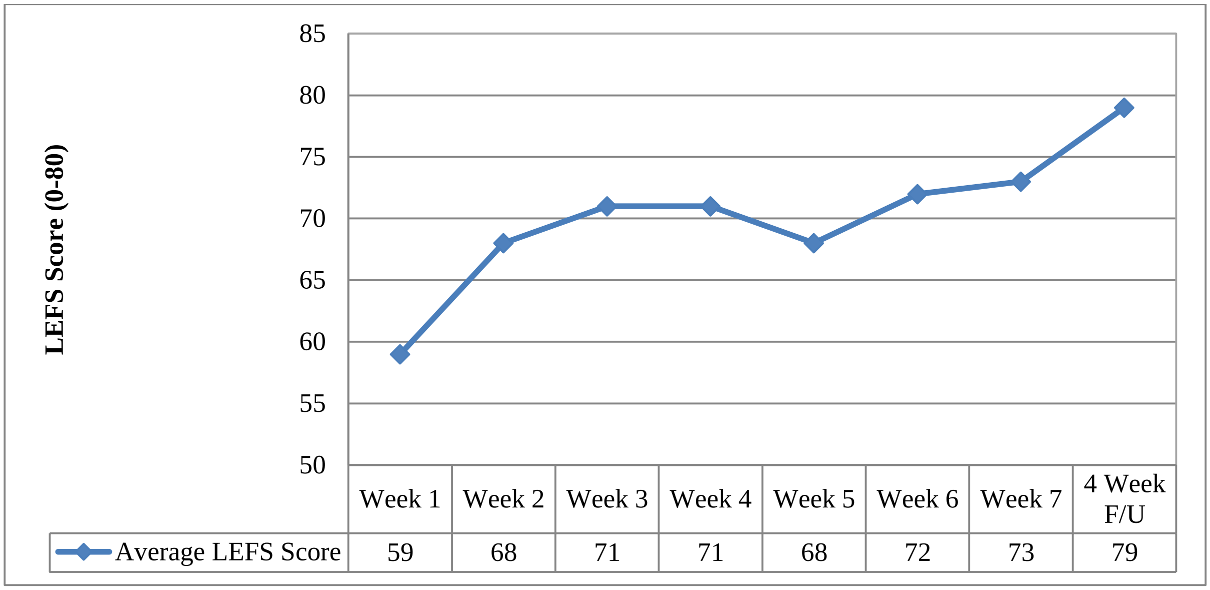
By analyzing the overall LEFS scores from the patients across all semesters, I can reflect on the efficacy of my overall treatment of chronic lower extremity injuries (Figure 3.12). On average, my patients scored a difference of nine points on the LEFS within the first week of treatment, which is the minimal clinically important difference (MCID) for the LEFS (Binkley et al., 1999). When examining the average long-term follow-up scores on the LEFS for 7 of the 11 patients, the average score was 79/80 (99% of maximal function). This statistic highlights the potential long-term benefits of the treatments when they are used for at least four weeks post-treatment.

Figure 3.11: LEFS Scores For All Lower Extremity Patients



*LEFS = Lower Extremity Functional Scale; MTSS = Medial Tibial Stress Syndrome; F/U = Follow-up; Pt. = Patient

Figure 3.12: Average Lower Extremity Functional Scale Score: Lower Extremity Chronic Pain Patients



*LEFS = Lower Extremity Functional Scale; F/U = Follow-up

Medial Tibial Stress Syndrome Patients

In the spring of 2015, I had set three specific goals for my treatment of MTSS patients and my collection of outcomes related to MTSS during the Fall 2015 semester. The goals were: 1) Utilize an RI approach to evaluate and treat MTSS patients and stay with one treatment for a longer period of time; 2 Take more detailed notes on each patients' progression 3) Use combination treatments that address the fascial restrictions that may cause MTSS. Thus, in the fall of 2015, I approached my patient care for MTSS patients utilizing the DPA Scale, LEFS, PSFS, and GROC. Additionally, I chose to treat my MTSS patients this semester from an *a priori* case series approach, working with other individuals in multi-site research.

Performing multi-site research has aided in my collection of better data for each patient, because I am held accountable to a specific research structure and *a priori* design, and I must use the global outcome measures listed in the previous paragraph. However, being under the multi-site *a priori* research design constrained my ability to change my treatment choice if a patient did not improve quickly.

As a multi-site research group, we chose to use the NDS system for classifying and treating patients with MTSS. We based our decision on prior successes with a combination treatment of NDS and PRT as well as on our knowledge of anatomy and physiology. Our patients were given four nerve provocation tests—sciatic, tibial, peroneal, and sural—because the compartments of the lower extremity are separated by fascia that is innervated by the sciatic, tibial, peroneal, and sural nerves (Levick, 2004b). Fascia is a continuous connective tissue through which the muscles of the lower extremity transfer force; therefore, if the nerves that innervate the fascia become constricted during repetitive muscle contractions, those nerves may transmit chronic pain signals to the brain (Benjamin, 2009; Kumka & Bonar, 2012). If MTSS pain is caused by deep crural fascial distortion, as it has been suggested, it may be plausible that a technique aimed at neurologic movement and therapy may decrease the pain stemming from the fascia in patients diagnosed with MTSS. Neurodynamics is a treatment method that targets the health of the nervous system by assessing and treating the mechanical interface made up of the nervous system and its adjacent tissues.

The first MTSS patient I treated in Fall 2015 (Patient 303) did not improve with isolated NDS treatment. In my journal, I recorded these thoughts about the *a priori* research design:

> *I understand that a case series must be structured and consistent to be of value in determining effective treatment methods for various injuries. Additionally, I believe that the information learned from the outcomes of this case series will be valuable regardless of whether we find NDS sliders to be effective in isolation at treating patients with MTSS. However, with a case series that is a-priori* [sic], *I begin to feel guilty when my patient is not seeing rapid improvement by the second or third visit. I try to justify in my mind why I am continuing the treatment if it is not working, and also justify my decision to the patient, which both prove to be difficult. Even though I only had five follow-up visits with the patient before I decided to move on, I would typically move on after only two visits after seeing little or mild improvement in a clinical scenario.*

After I finished the five treatments using NDS for our case study, I reevaluated Patient 203 and changed my treatment to the MC lateral ankle sprain fibular Mobilizations With Movement (MWM). I based my decision on a clinical evaluation that revealed restricted dorsiflexion and “tightness” in the talocrural joint. Using the treatment, my patient saw immediate and long-lasting pain relief and reported an 8/10 on the NPRS prior to treatment and 0/10 immediately after the first treatment. We performed one treatment session, and the patient never reported any other complaints or pain for the remainder of his sport season. This patient case reinforced my prior RI approach to evaluating MTSS patients, which was to treat the factors that may be causing the pain. In my future practice, I will consider using the MC MWM for patients complaining of ankle restriction with concomitant MTSS symptoms. I may also use NDS and PRT as a TBC approach for determining how the patients respond to quick treatment interventions. This approach will help me to sub-classify my patients and individualize their programs based on how they respond to quick treatments.

When comparing my MTSS PROMs from Spring 2015 to Fall 2015, it is evident that overall my patients did not improve faster using an isolated NDS treatment approach than they did to a combination of NDS and PRT (Tables 3.3, 3.4; Figures 3.13, 3.14). However, one piece of information that may skew the data in favor of the PRT and NDS treatments that were used during the fall semester is that the NPRS scores were reported "during activity," and not reflectively for "worst" pain.

Three semesters of PROMs on MTSS patients shows that my patients were discharged after an average of 27 days of treatment, which is considerably faster than the recovery times reported in the current literature (between 60-117 days with standard treatments or no treatment at all) (Nielsen et al., 2014; Schulze et al., 2014; Moen et al., 2012). These PROMs data demonstrate my clinical growth in treating patients with MTSS. In the future, as I progress toward advanced practice, I will continue to use PROMs in the AR cycle to evaluate and treat patients effectively.

Table 3.3: MTSS Patient's NPRS Outcomes Comparison by Treatment Type

Scale	***NPRS Worst***			***NPRS During Activity***		***NPRS Worst***	
Treatment	***Myokinesthetics***			***PRT + NDS***		***Isolated ND Sliders***	
Patient	***101***	***102***	***106***	***207***	**208**	***303***	***306***
Week 1	4	3	6	7.5	3	6	2
Week 2	3	3	5	1	3	7	9
Week 3	7	0.5	5	-	0	8	0
Week 4	5	0	3	-	-	MWM	-
Week 5	3	-	-	-	-	0	-
Week 6	2	-	-	-	-	-	-
Week 7	2	-	-	-	-	-	-
4 week F/U	2	0	3	0	-	-	-

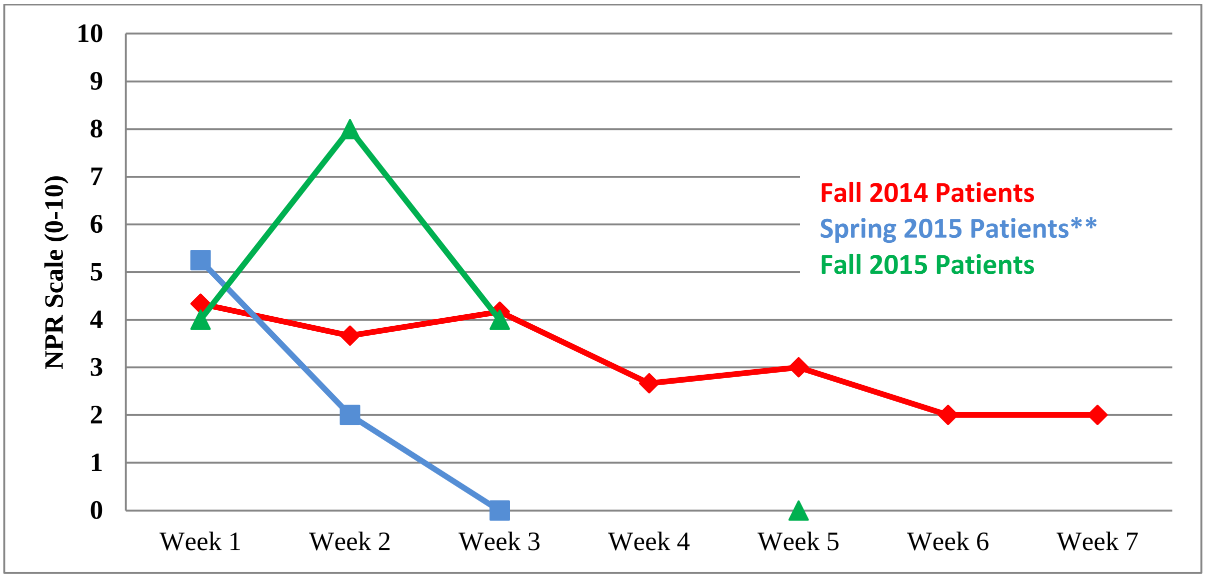
* MTSS = Medial Tibial Stress Syndrome; NPRS = Numeric Pain Rating; PRT = Positional Release Therapy; NDS = Neurodynamic Sliders; MWM = Mobilization With Movement

Table 3.4: MTSS Patient's Global Outcomes Comparison by Treatment Type

Scale	***Lower Extremity Functional Scale***						
Treatment	***Myokinesthetics***			***PRT + NDS***		***Isolated NDS***	
Patient	***101***	***102***	***106***	***207***	**208**	***303***	***306***
Week 1	88%	84%	89%	69%	58%	67.5%	68.75%
Week 2	81%	94%	88%	95%	86%	83.75%	73.1%
Week 3	74%	98%	94%	-	94%	80%	80%
Week 4	84%	99%	95%	-	-	(MWM applied)	-
Week 5	92.5%	-	-	-	-	100%	-
Week 6	90%	-	-	-	-	-	-
Week 7	92.5%	-	-	-	-	-	-
4 week F/U	94%	100%	96%	100%	-	-	-

* MTSS = Medial Tibial Stress Syndrome; NPRS = Numeric Pain Rating Scale; PRT = Positional Release Therapy; NDS = Neurodynamic Sliders

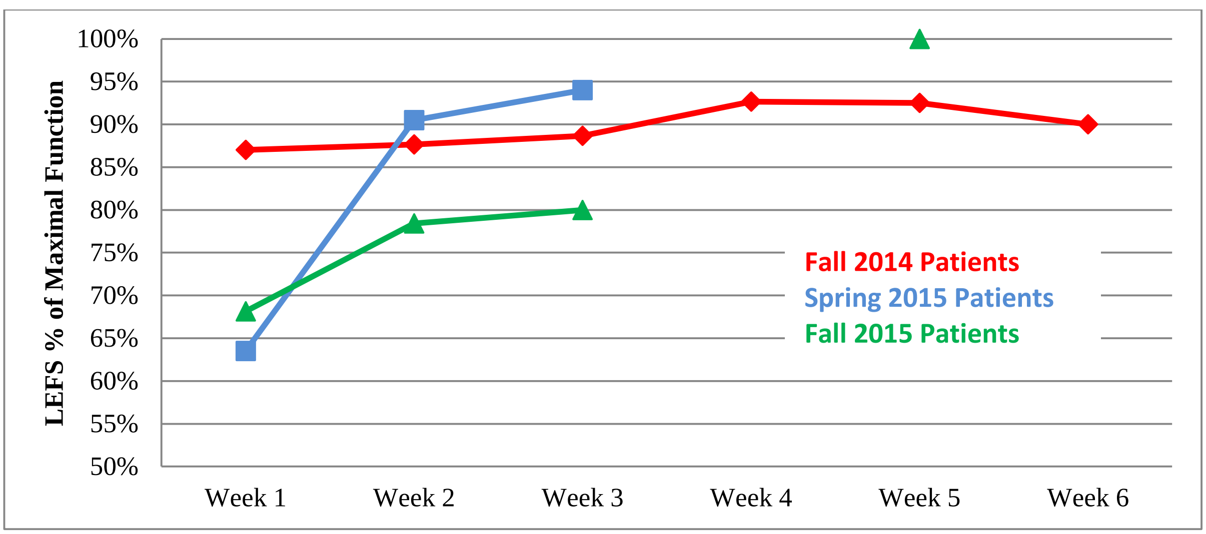
Figure 3.13: Numeric Pain Rating Scale Changes By Treatment Application: MTSS Group Averages



*NPRS = Numeric Pain Rating Scale

**NPRS for this group was rated as a patient-specific impairment measure during running. Other groups were rated as "worst."

Figure 3.14: Lower Extremity Functional Scale Changes By Treatment Application: MTSS Group Averages



*LEFS = Lower Extremity Functional Scale

Patellar Tendinopathy Patients

At the beginning of the DAT program, I treated my first two patients with a local treatment. One patient (Patient 103) improved quickly, while the other patient (Patient 105) did not improve at all. During the Spring 2015 semester, after successfully treating a patient with patellar tendinopathy using a an RI approach, I made a goal for myself that I would use an RI approach to evaluation (including psychosocial PROMs) and treatment of future patients with patellar tendinopathy. As such, in the fall of 2015, I shifted my focus to include the SFMA as a guide. I also used the DPA Scale instead of the LEFS to try to identify potential psychosocial factors that may contribute to or perpetuate the pain experienced by patients with patellar tendinopathy.

In Fall 2015, I had one patient with patellar tendinopathy (Patient 313). My SFMA evaluation led me to perform a breakout, where I identified that the patient had core SMCD. During my standard evaluation, I discovered an upslip of the left sacroiliac joint along with over-facilitated quadriceps. I addressed the upslip through TMR and strain-counterstrain technique, and the core SMCD through rolling pattern retraining. I inhibited the quadriceps through Primal Reflex Release technique. Throughout the treatment, the patient consistently reported improvement. Prior to the treatment, the patient had been restricted from all activity, had received ultrasound and massage, and had stayed the same in regards to pain or had reported more pain than before treatment. After I addressed the patient's dysfunction and performed treatment using the SFMA model, the patient's NPRS "worst" score dropped from an 8.5/10 to a 1.5/10. In four weeks, his DPA Scale score dropped from a 26 to an 8 (Figure 3.15).

When I reflected on my PROMs from this semester, I noticed that my two patients with patellar tendinopathy (Patients 201 and 313), upon whom I had used the SFMA for evaluation, exhibited similar trends in their PROMs. Of the patients for whom I had prescribed local treatment, one improved within three weeks, and the other never improved. Overall, my patients were discharged in an average of 28 days with an average NPRS "worst" rating of 2.1, which is significantly better than the reported 3-12 months (Khan et al., 2001; Kountouris & Cook, 2007). Furthermore, Young et al. (2005) demonstrated that patients who suffered from patellar tendinopathy did not improve after eight weeks of rest. Therefore, my clinical progress with patellar tendinopathy patients is evident in my progression through the three semesters of residency in the DAT program.

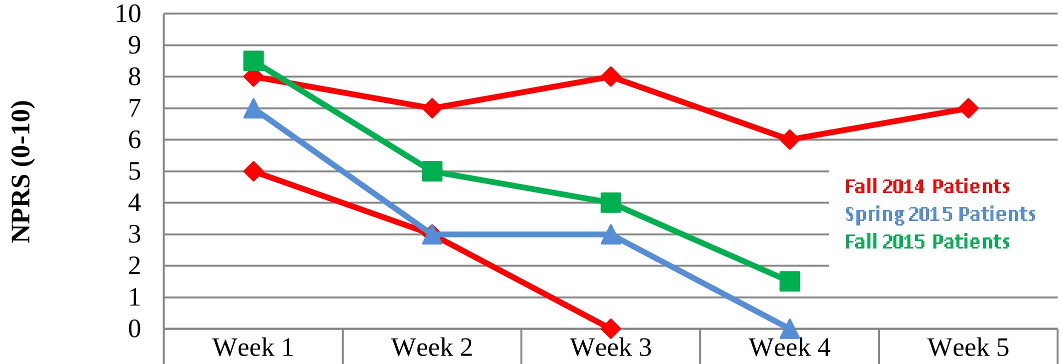
Based on my reflection of my last three semesters of residency, my clinical take-home point is to continue to search for factors outside of the area of pain that may influence patellar tendinopathy. Although I have only recorded outcomes for four patients over the past three semesters, their outcomes have led me to believe that I am able to make more of a difference using an RI approach than if I continued to utilize local treatment. Overall, there is still room for improvement in treating patellar tendinopathies in my clinical practice. As I progress in my treatment of patellar tendinopathy, I would like to improve on my use of psychosocial treatments, such as breathing pattern assessment and treatment, trauma releasing exercises, and progressive relaxation. As I become more comfortable with trying new paradigms, I believe that my patients will reap the benefits of these new treatments. As I continue to collect outcomes on patellar tendinopathy patients in my future practice, I will compare my prior PROMs with the current PROMs. This will help me to reflect and improve on problems that are specific to my clinic.

Table 3.5: Patellar Tendinopathy Syndrome Patients Comparison by Treatment System

Scale	***NPRS* Worst***				***LEFS****			***DPA Scale****
Treatment	***Massage/Ecc***		***SFMA****	***TMR*+ PRRT****	***Massage/Ecc***		***SFMA***	***TMR + PRRT***
Patient	**Pt. 103**	**Pt. 105**	**Pt. 201**	**Pt. 313**	**Pt. 103**	**Pt. 105**	**Pt. 201**	**Pt. 313**
Week 1	5	8	7	8.5	65%	50%	86%	26
Week 2	3	7	3	5	67%	67%	93%	26
Week 3	0	8	3	4	80%	58%	95%	15
Week 4	-	6	0	1.5	-	61%	96%	8
Week 5	-	7	-		-	62%	-	

*NPRS = Numeric Pain Rating Scale; LEFS = Lower Extremity Functional Scale; DPA = Disablement of the Physically Active; TMR = Total Motion Release; PRRT = Primal Reflex Release Technique; SFMA = Selective Functional Movement Assessment

Figure 3.15 Weekly Reported NPRS "Worst" – Patellar Tendinopathy Patients



	Week 1	Week 2	Week 3	Week 4	Week 5
Pt. 103	5	3	0		
Pt. 105	8	7	8	6	7
Pt. 201	7	3	3	0	
Pt. 313	8.5	5	4	1.5	

**NPRS = Numeric Pain Rating Scale; Pt. = Patient*

Low Back Pain Patients

One of my goals for the fall of 2015 was to improve on my evaluation and treatment of patients with non-specific low back pain (LBP). Low back pain, defined as "pain localized below the line of the twelfth rib and above the inferio gluteal folds, with or without leg pain," is a prevalent complaint among the general population (Chevan & Clapis, 2013). The risk factors associated with LBP are related to demographics such as gender, education, and marital status (Chevan & Clapis, 2013). Low back pain is treated in a variety of ways, including therapeutic exercise, spinal mobilization, and physical modalities (Chevan & Clapis, 2013). Because LBP is not a true pathology, but a symptomatic complaint, it is important for clinicians to reach an accurate diagnosis of the cause(s) of pain for each patient. A TBC model may be the most effective approach for a clinical presentation of LBP. The TBC model involves testing a variety of treatment methods to determine the most efficacious intervention, as well as the prognosis. Patient-reported outcome measures are also used (Chevan & Clapis, 2013).

In the Fall 2015 semester, I had two patients with LBP (Patients 309 and 310). I learned a plethora of lessons during this experience; however, I will only include a portion of a time-sensitive journal entry about these patients, which will serve to denote the growth that I experienced as a result of treating these individuals. The journal entry is entitled, "My Outcomes are Not MY Outcomes: Addressing the Patient in Patient Care." These few paragraphs summarize the greatest lessons I learned this semester about improving my patient care, not just for patients with low back pain, but for all of my patients:

> ***Intro: Psychosocial In Real Life***
> *This semester I have had one or two patients who are in chronic pain who* [sic] *I just can't seem to get better. Both of these patients are very similar in that their symptoms seems* [sic] *to keep jumping around from body part to body part. Both patients, I suspect after getting to know them better, have some underlying psychosocial variables that may be causing or accentuating the symptoms of chronic pain…*
> ***…Chapter I: The Shoulder Angels***
> *As I was wrestling with what to do next with one of my patients, I was struck by a conversation I had with a friend about the situation. This friend advised me to simply refer the patient to the physician to rule out systemic causes, and then essentially wash my hands clean of the patient because I wouldn't be able to fix the underlying issues. One point that my friend made was that we are dealing with division III athletics, where the patients are usually not very coordinated to begin with. If we waste our time trying to chase the issue, then we are giving up our time trying to chase the pain instead of helping the other patients who* [sic] *we have the power to help. In one sense, I felt myself agreeing with him (I could almost see the shoulder angels). In my head I began to rationalize according to this type of thought, "What can I actually do? I am tired of chasing the pain, and I have no idea where it is coming from. Someone more qualified than me can probably address those underlying issues, I will just refer her." But, on the other hand, I was not comfortable with just letting a patient go to a physician because I know they will likely either give her pills or tell her to rest. I realized deep down what we had talked about so long ago (Summer I DAT) was so true. I was wanting to get rid of this patient for selfish reasons because I felt like a failure when she came in. The easiest way to get rid of my own shortcomings as a clinician was simply to refer and wash my hands clean. But, after realizing that I was more caught up with MY outcomes than HER outcomes, I began to truly try resolve* [sic] *to stay with her until the end. So I was struck with a question that Dr. N made even more clear when I talked to him about this patient: "If I am not going to help her, who will?" …*
> ***…Chapter 2: The Reinforcement***
> *With a new resolve (but still naivety when it comes to "treating" psychosocial issues), I began to look for techniques I could use or approaches I could take with this patient. Again, I had to stop myself because I tend to think "If I apply this treatment to her, then what will happen?" In the middle of my thinking through this I watched the NES videos by Dr. David Magee on*

Lumbar Spine assessment. In the video he says of his mentor: "He could get most of his patients better with two cups of coffee and two chairs." After this and talking with Dr. N, I began to realize what I was missing was exactly this component of patient care. I had lost the forest in the trees, as I thought about "applying" a treatment instead of getting to know the patient.

Chapter 3: Keeping It Under Wraps

After reflecting on this aspect of patient care, I realized that as I began my new job as full-time faculty, I was being much more "formal" with my patients because I was less comfortable with my surroundings. Also, never before had I had to take a lot of time to get to know my patients in depth in a 30 minute visit because I saw them every single day and got to know each one of them well at practices and games and during travel. (If there is one benefit of the sports model of coverage, I think this is probably it. . . conversation for another day). In my seasons with sport assignments I took for granted that my patients saw "Bobby" and not "fake clinic AT Bobby." All of this is not to say that one cannot be themselves [sic] *in a medical-model of patient care, but simply that I was not practiced or comfortable with being myself around patients in this type of setting. Because I felt I had to prove myself to my patients in a limited amount of time, I was more "cut to the chase" and forgot the most important aspect of patient care. . . the patient.*

Conclusion: The Little Things

Instead of looking for a treatment paradigm (which I will do eventually), I realized that I first needed to start taking care of the little things in my practice. I first started by making "my" practice less about me. Particularly, as I thought through my patient who was struggling with chronic pain, I realized that although we had some conversations about her home, life, and hobbies, I had barely scratched the surface of who she actually is as a person. This week, I cancelled rehab one day, and another day we had a long conversation about anything and everything. Not only was the patient relieved that we had cancelled her rehab, I saw her demeanor change considerably after we had talked. I do not know if her pain changed, and I did not ask because I did not want her to focus on her pain at this moment in time (she had been keeping her pain rating numbers on her phone every day during every moment of the day so she could tell me what they were, which I think was becoming almost obsessive), I simply wanted to get to know her better and get her mind off of her pain.

Thus, through my treatment of patients with LBP during the Fall 2015 semester, I learned some vital lessons about the importance of facilitating treatment for my patients and becoming more patient-focused in my practice.

Residency Impact

In the DAT program, we had discussions with peers and faculty about the best ways to stimulate positive change in our residency sites. Some clinicians may be tempted to be confrontational and boisterous with the new information they are learning, but my preferred leadership style is servant leadership, where I let my actions "speak" louder than my words (Kutz, 2012). When I want to teach my colleagues a new technique to treat a patient, instead of simply correcting them or directly telling them a better way, I prefer to let them see my successes with patients, and then, after they approach me about my treatment, I explain to them what I am doing, or ask them questions to guide their thinking. As I grew in my knowledge and practice, I realized that others were watching what I was doing. Eventually, I was approached by colleagues, students, and patients with questions about athletic training practice. Throughout the course of the DAT program, I was able to be an ambassador for positive change in my clinical residency sites. As I grew in my knowledge of EBP, PBE, and AR, I was able to disseminate my findings to colleagues, students, and patients.

The first change that I noticed in my clinical residency (after the adjustments I made in my own practice) was the change in my colleagues. As I altered my practice, I gained some incredulous looks from my peers; but, eventually, I was approached with questions about my practice and about techniques that I had been using on my patients. A time-sensitive narrative, written during the Fall 2014 semester and entitled, "Creating a Collaborate Workplace Environment," highlights how I was able to influence my colleagues at Erskine College:

> *Yes, it's a bit cliché, "Be the change you wish to see in the world." However, I have found new meaning from this quote in recent weeks. When we talked this summer about making small changes that were seemingly insignificant but that it would be noticed by those around us, I was incredulous. Yes, my thoughts are changing, and I am trying new things, but internally I feel less confident in my skills than I ever have been* [sic]*…*
>
> *…However, this week I began to see some of the fruits of my toil, as I received outside affirmation in two ways from those around me. It is actually amazing that my friends are noticing changes in me and it seems to be positively affecting my whole workplace. Two accounts from this last week left me almost floored:*
> *1. A friend and colleague asked me in the middle of a Mulligan treatment, "So, what is this thing that you're doing?" She went on to explain that she needs to learn it, because all of the patients are asking for me in the clinic when I am not there. Further, this friend went on to say that she thinks we should have sessions where we disseminate the new techniques and knowledge that we are learning with each other as colleagues regularly. I was so excited by this, not in a haughty way, but that I actually seem to be changing! Up until this point, I wondered if I was changing for the better at all. But, this got me very excited because I want to foster the environment where my colleagues and I are regularly talking about patients, treatments, and techniques. This will only help to sharpen our skills,* [sic] *ideas, and facilitate*

> *reflection in our practice. And all of this came about without me mentioning or saying anything related to these ideas! It came about just from me keeping my head down and doing what we practiced in the DAT* [sic]*, showing my value as a clinician and constantly reflecting on and conscientiously improving my practice.*
> *2. In the same day, another friend and colleague approached me about a patient that he has who has been struggling with MTSS. Since I have been pouring myself into patient outcomes for MTSS and studying how to improve my treatments for these patients (I've talked with him about this a few times), he asked me if I would like to try to work with his patient. I gladly agreed, again hopefully not from a haughty standpoint, but from the standpoint that I would love to get to the bottom of MTSS and find a better treatment. The more patients I can see for this particular case, the better clinician I will become at dealing with this injury. I am humbled that my colleague was kind enough to let me try some techniques on his patient and very grateful for the wonderful working relationship that we all have here! In fact, this colleague expressed the desire to sign up for the DAT program in the near future.*
> *Both of these incidents encouraged me that* [sic] *simply by trying to be more intentional about my practice, the environment around me is changing into one that is more reflective, more collaborative, and more focused on patient-care and improving that care. Both of the events described above caught me completely off-guard and* [sic] *am so grateful for "being the change I wish to see." I came into this semester not knowing how my changes and efforts would be received by those around me, doubting whether my practice was actually changing at all, and highly questioning whether anything that I am doing would affect my work environment or practice. But, these are the changes that are happening by being quiet, resolved, reflective and continuing to humbly but confidently work towards improving my practice. I cannot wait to collaborate with my colleagues, share ideas, and help each other as we sharpen our skills and knowledge in our chosen areas.*

In addition to making a positive impact on colleagues at Erskine College, I was able to implement EBP, PBE, and AR techniques in my students' practice. When I arrived back at Erskine College after my first summer in the DAT program, I had many ideas of how I wanted to change my practice; however, I had not thought about how I was going to teach my students these new concepts. As I became more comfortable with the techniques and with organizing EBP research, I was able to show my students how to use PROMs and how to collect and analyze meaningful data from patient care. In fact, right before I left Erskine College for my employment at Waynesburg University, I had made a plan with the program director to have every one of our students perform AR projects using PROMs for their senior project. To the best of my knowledge, this was implemented. And even though I am now working at Waynesburg University, I am still mentoring and helping a student at Erskine with her senior AR project on MTSS.

Lastly, I was able to make a positive impact on patients at Erskine College. My PROMs in the previous sections highlight my positive impact on my clinical residency site. I was able to improve my patients' well-being, and I was able to empower them to heal themselves. My time-sensitive narrative journal entry from Fall 2014, entitled, "Patellar Tendinopathy Patient Part 2 (Affirmation)," is evidence of the impact I had on my clinical site, students, and patients:

> *…The other part of this story that is kind of neat is that while I was performing the SFMA on this patient, an athletic training student of mine asked what I was doing. Before I could answer, another student in the clinic chimed in and explained a little bit about it, adding "it seems like all of Bobby's experiments always work really well." As this conversation was happening, another patient of mine that I had helped earlier in the semester with the SFMA walked in and started raving about it to the patient I was working with. He went on to explain all of the details about how "this stuff really works, instantly!" And "I was only able to raise my hip this much (10 degrees) when I came in, and I left after rolling on the floor and was able to raise it all the way up." These words from my previous patient helped instill confidence in my current patient (and also in me). I found myself getting excited about what I was doing again, remembering some of my successes earlier, despite my many failures this semester. The encouragement also helped me to gain a more broad* [sic] *perspective on my clinical practice in general, realizing how far I have come since the beginning of the summer. The perspective was certainly welcomed, because most of the time I am narrowly focused on how many areas of my clinical practice need work, and all of the techniques that I feel unequipped to handle. At the end of the semester, on my last day in the clinic I realize that I have learned so much, and hopefully helped some people in the process, and that's why I love my job! I look forward the continual process of improving, learning and growing in the many years to come.*

As I transitioned to my job at Waynesburg University, I realized that I had to restart the process of influencing and learning from a new group of people. However, at this point I was more confident in my skills and more steadfast in my approach to patient care. Because my colleagues at Waynesburg University had already adopted AR principles and the steady collection of PROMs in practice, my transition was much easier than I had anticipated. As I prepared for my last semester of clinical residency in Fall 2015, I noticed my new students asking many questions about the techniques I was using, such as the MC, TMR, PRT, TRE, and breathing pattern disorder resetting. As a full-time instructor treating patients through referral, I was able to have a large impact on the program, particularly on the way students learn about the concepts of EBP and PBE and the way they implement those concepts in their own practices. For instance, I have assigned readings about EBP, PBE, and PROMs from journals. Additionally, my colleagues and I have developed a plan for students to perform their own AR and then make portfolios of their PROMs to present their senior year (similar to what is done in the DAT program). Just as I have learned to analyze outcomes data, which is made evident through this DoCPI, my students are learning how to try new techniques, just as I did during my clinical residency in the DAT program.

Final Reflection

Through effectively analyzing PROMs collected over the course of three semesters of clinical residency, I have demonstrated growth in and an ability to reflect on my clinical practice. In Fall 2014, I was unsure of how to best collect and organize PROMs. I did not use a great variety of PROMs, and I demonstrated a “shotgun” approach to my patients’ care by switching my treatments every day instead of seeing one treatment method through. My sporadic approach and poor note-keeping made it difficult to determine the effectiveness of specific techniques on particular injuries. Even though my patients saw a trend of improvement for their lower extremity injuries, I had need of improvement, as a clinician.

As I approached the Spring 2015 semester, I began to collect a greater variety of PROMs, and I started using only one treatment method at a time. Thus, my Spring 2015 PROMs allowed me to analyze my practice with more detail and to set specific goals for improving my patients’ well being for the fall of 2015. At the end of the spring, I outlined several goals for improvement. These included taking more detailed notes, using new PROMs, and not switching treatments so quickly.

In the Fall 2015 semester, I changed my residency site. At Waynesburg University, I treated fewer total patients but was able to glean valuable insight into treating patients with LBP and other chronic conditions that were not “straight forward.” Although my PROMs showed little improvement from Spring 2015 to Fall 2015, I grew the most this semester. I attribute this growth to being challenged to look outside of the biomechanical model when treating my patients. My philosophy shifted over the course of the Fall 2015 semester to incorporate a more holistic approach to patient care. In addition, I was less afraid to try treatments of which I had been skeptical, previously.

The DAT program has completely reformed my philosophy of rehabilitation and my approach to patient care. I have learned and practiced the concepts of EBP, PBE, and AR, the combination of which offers a sustainable, cyclical framework for future clinical growth. I have chosen an area of advanced practice in chronic lower extremity muscle injuries and have learned how to use PROMs and reflection to improve my evaluation and treatment of patients who fall into this category. Through my reflective journal entries, I have learned to be candid about my failures and the barriers that stand in the way of my improvement. This, in turn, has helped me overcome and improve my patient care. I have also been able to share my growth with colleagues and with athletic training students, which has impacted my residency site. As my students go out to new locations to work in the future, they, in their turn, will impact the larger athletic training community.

I am excited to help change athletic training and patient care for the better. I will focus on improving my own knowledge and my application of EBP, PBE, and AR by identifying problems, researching those problems, forming plans to solve those problem and implementing my plans, reflecting on the results of my methods, and setting new goals. I will also establish more program standards for students at Waynesburg University as my colleagues and I form a curriculum for a Masters of Athletic Training program. The new program at WU will incorporate AR and translational research into the students' daily practice to improve patient care and advance the athletic training profession. I am truly excited to be on the forefront of a philosophical and professional shift in athletic training, and I am ready to be an ambassador for change, here in the site where God has placed me.

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CHAPTER 4

CRITICALLY APPRAISED TOPIC MANUSCRIPT

4.1: Changes in Hamstring Range of Motion Following Proprioceptive Neuromuscular Facilitation Stretching Compared With Static Stretching: A Critically Appraised Topic

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Clinical Scenario

Stretching is commonly used in the medical, health, and fitness fields, as well as in school and military settings to increase flexibility and range of motion (ROM) at various joints.[1-3] Static stretching has been used for many years and requires the individual to lengthen the muscle to end range and hold this position for varying amounts of time.[4-6] Numerous studies have been performed to understand appropriate stretch duration; however, treatment application varies between five to 60 seconds.[4,7-9] Proprioceptive neuromuscular facilitation (PNF) stretching is another type of stretching used frequently to increase ROM.[5,10] A combination of contraction and relaxation of either agonist or antagonist muscles is used during PNF stretching.[5,6,10,11] Although both static and PNF stretching techniques have been touted as effective, there remains a need to identify whether one method is more effective than the other when focusing on the hamstrings musculature.

Several researchers have performed comparison studies to determine the most effective stretching technique and protocol for increasing ROM measures. A previous systematic review of PNF was performed to complete general comparisons for PNF and static stretch techniques for range of motion gains. The previous systematic review was published in 2006, and included studies that were not exclusive to hamstring ROM.[12] Therefore, there was a need to critically appraise the literature regarding the effects of PNF and static stretching on hamstring ROM. Critically appraising the efficacy of static versus PNF stretching in individuals with tight hamstrings may offer important insight into use of these techniques in clinical practice when treating individuals presenting with tight hamstrings.

Focused Clinical Question

In individuals with hamstring tightness, what is the effect of using PNF stretching compared to static stretching on traditional measures of hamstring ROM?

Search Strategy

A computerized search was completed in April 2015 (Figure 1).

Terms Used to Guide Search Strategy

- **P**atient/ Client group: Healthy adults with or without hamstring tightness
- **I**ntervention/Assessment: PNF OR proprioceptive neuromuscular facilitation
- **C**omparison: static stretching
- **O**utcome: flexibility OR range of motion

Sources of Evidence Searched

- CINAHL Plus
- Health Source
- SPORTDiscus
- PubMed Central
- Additional references obtained via reference list review and hand search

Inclusion Criteria

- Limited to studies that compared PNF stretching to static stretching
- Limited to studies that included individuals classified with tight hamstrings but absent of any additional pathology. Tight hamstrings are defined as 20° from vertical on the knee extension angle (KEA)[5] or active knee extension (AKE)[6,10] measurement with the hip at 90° of flexion.
- Limited to articles written in the English language

- Limited to articles written in the last 10 years (2005-2015)
- Limited to Level 4 evidence or higher

Exclusion Criteria

- Studies that used minors as participants
- Studies that used an injured population as participants
- Studies that did not compare PNF stretching to static stretching
- Studies that did not include pre- and post-treatment mean ROM outcomes

Evidence Quality Assessment

Validity of the selected studies was assessed using the Physiotherapy Evidence Database (PEDro) scale (Table 2). The three included articles were identified on the PEDro website with accepted and approved scores; these scores were utilized in this critically appraised topic (CAT).[13]

Results of Search

Three relevant studies were located using the search terms identified in the *Search Strategy* section. As described in Table 1, the studies selected for inclusion in this CAT were identified as the best evidence. The authors of these Level 2 studies considered the effects of static stretching in comparison to PNF stretching on traditional measures of ROM in individuals classified with hamstring tightness.

Summary of Search, Best Evidence Appraised, and Key Findings

- The literature search identified 202 studies; two randomized controlled trials (RCT) and one comparative crossover study met the inclusion and exclusion criteria (Table 1).
- In all of the studies that met inclusion and exclusion criteria, PNF stretching was compared to static stretching, with hamstring range of motion measurements as a primary outcome measure. In one study, an additional comparison was made to active self-stretch.[5]

- In the three studies that met inclusion/exclusion criteria, hamstring tightness was determined by the AKE [6,10] or KEA.[5] Tight hamstrings are defined as 20° from vertical on the KEA[5] or AKE[6,10] measurement with the hip at 90° of flexion.
- In all three studies, ROM measurements were taken with the participants in supine with the contralateral limb secured to the table with Velcro straps. The involved limb was placed in a 90° of hip and knee flexion. The participants actively extend the knee[5, 10] or an examiner passively extended the knee to record the measurement.[6] The AKE[6,10] or KEA[5] measurements were recorded using a digital inclinometer[5,6] or a manual protractor.[10]
- The PEDro scores were obtained from the Physiotherapy Evidence Database. Although the studies selected for inclusion in this CAT were identified as the best evidence, the average PEDro score for included articles was 4.33/10 which indicates low-quality evidence.
- Of the articles included, the authors of two studies[6,10] indicated that both PNF and static stretching resulted in significant gains on the AKE[6,10] with no significant difference between techniques; however, the authors of one study[5] reported that static stretching was more effective. The best evidence for stretching techniques to increase ROM in individuals with tight hamstrings remains inconclusive.

Results of the Evidence Quality Assessment

As indicated previously, the PEDro scores provided guidance in determining the validity of each article. Evaluating the articles based on the PEDro criteria indicated lower validity with scores of three[5] and five.[6,10] Areas such as eligibility criteria,[5,10] concealing allocation of subjects,[5,6] blinding (subjects/therapists),[5,6,10] follow-up,[5,6,10] and an intent to treat analysis[5,6,10] were non-existent in the majority of the articles leading to the lower PEDro scores (Table 2).

Clinical Bottom Line

For individuals with hamstring tightness, there is low quality evidence to suggest either PNF or static stretching are more effective at increasing ROM. The effectiveness of PNF stretching compared to static stretching is inconclusive. Researchers in one[5] of the three included studies found that static stretching was more effective than PNF stretching, while the other two groups of researchers determined that both methods were equally effective at increasing ROM measures in healthy individuals with tight hamstrings.

Strength of Recommendation

Grade D evidence exists that PNF stretching performs as well as static stretching at increasing measures of hamstring ROM in individuals with limited hamstring flexibility. The Oxford Center for Evidence-Based Medicine recommends a grade of D for troubling inconsistent or inconclusive studies as found within this CAT.[14]

Implications for Practice, Education, and Future Research

In the appraisal of the three included studies in this CAT, Davis et al.[5] found static stretching to be more effective at increasing KEA measurements than PNF-R (i.e., agonist contraction) and active self-stretch. The researchers attributed the superior ROM gains of the static stretch intervention to the facilitation of the GTO during the static stretch, whereas the active contraction of the agonist muscle during the PNF-R stretch may facilitate the hamstring muscles, limiting the muscles' ability to relax and elongate.[5,12] In contrast, Lim et al.[10] found both static stretch and PNF hold-relax technique to be effective at increasing AKE measurements acutely; however, no significant difference was found between the stretching techniques. These outcomes were comparable to Puentedura et al.[6] who compared similar stretch interventions.

The lack of significant findings between interventions could be attributed to the variance in methodology for both the static stretch and PNF stretching interventions. First, for the static stretch intervention, Lim et al.[10] and Puentedura et al.[6] performed a single treatment session consisting of one[10] or two[6] sets of 30 second stretches. Davis et al.[5] utilized two sets of 30 seconds performed three times per week for a duration of four weeks. Davis et al.[5] asserted that significant hamstring length cannot be achieved utilizing a protocol that includes a duration of less than two weeks and a 30 second stretch intervention. Other researchers have supported this theory by suggesting that a single, same-day series of an acute static stretch intervention will produce only transient ROM gains.[15-18]

Due to the lack of consistent methodology and results within the static stretching literature, comparison between the studies is difficult and clinical relevance of the results is questionable. Davis et al.[5] applied a passive straight leg raise (PSLR) to the point of a strong, but tolerable stretch sensation for the subject. Similarly, Lim et al.[10] also applied a PSLR; however, the stretch was applied to the point of light tolerable pain for the subject. Puentedura's et al.[6] methods were significantly different as they included a warm-up and may lack clinical relevance due to the inclusion of a pulley system that applied an arbitrarily chosen amount of torque to provide the passive stretch.

The lack of significant findings between interventions may also be attributed to the variance in methodology for the PNF stretching technique. Davis et al.[5] utilized an agonist contraction method for PNF stretching that involved a single 10 second active concentric contraction of the quadriceps muscle followed by a 30 second static stretch hold. In contrast, Lim et al.[10] incorporated a PNF hold-relax technique where subjects isometrically contracted their hamstrings against resistance for six seconds followed by a five second relaxation period, for a total of three sets.[10] Additionally, Puentedura et al.[6] also utilized the PNF hold-relax technique with a 10 second isometric contraction followed by a 10 second passive stretch for four total sets.

Based on the appraisal of the available evidence and identifying inconsistent stretch intervention methodology, determining a superior stretch intervention when comparing static to PNF stretching cannot be accurately accomplished based on the current literature. A comparison of the studies is difficult due to methodological differences. Additional high quality studies with standardized PNF and static stretching protocols are needed to determine the most effective stretching intervention. Further, if researchers are hoping to impact clinical practice and determine most effective stretching interventions that will translate to individual care, the application of the techniques that can be used within a clinic should be considered when determining methodology.

Based on the findings of the researchers, it appears that clinicians may utilize either static stretching or PNF stretching to achieve acute modest gains in range of motion; however, more high-quality research must be performed utilizing consistent methodology to determine the clinical efficacy of each stretching intervention. Additionally, both PNF and static stretching techniques should be compared to other techniques aimed at increasing ROM to determine the most effective intervention for clinical practice. Future studies should be focused on identifying the most effective stretching protocol for increasing ROM, both short and long term, using a high quality blinded randomized control trial. The current CAT should be reviewed in two years to identify whether additional evidence exists that may alter the clinical bottom line of this clinical question.

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Figure 4.1: Search strategy

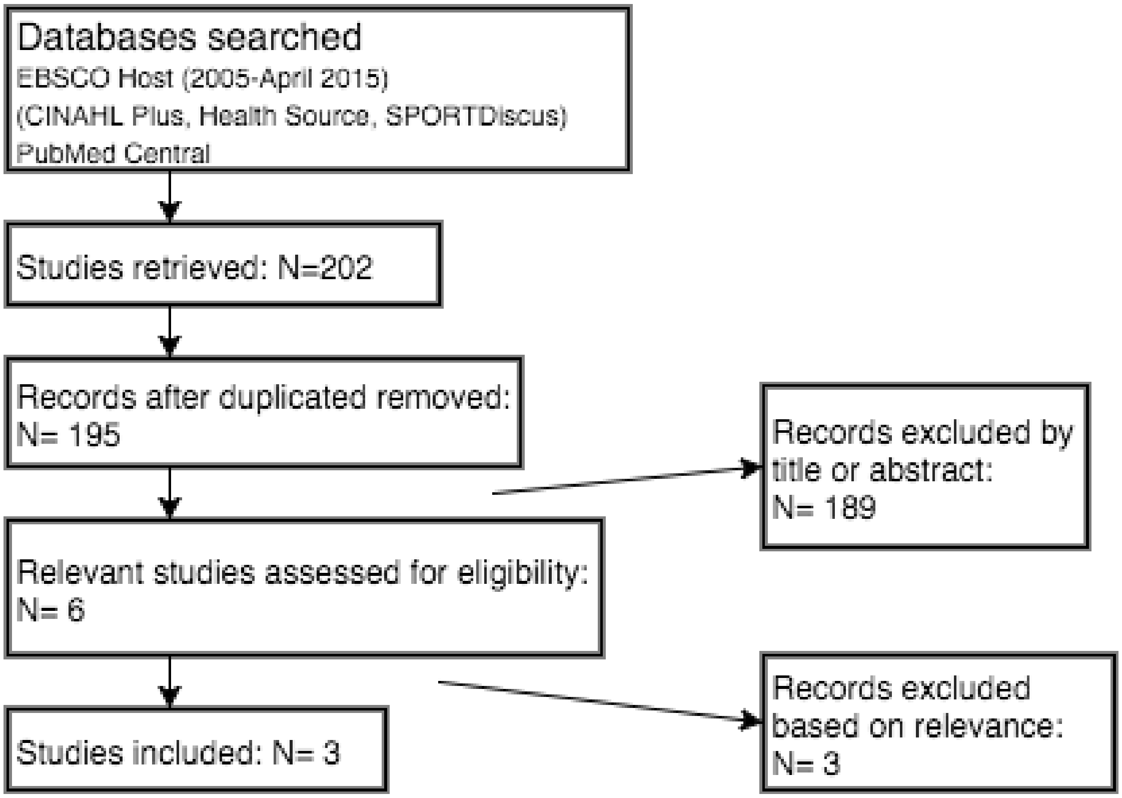

Table 4.1: Results of PEDro scale for each article

	Davis et al[5]	**Lim et al[10]**	**Puentedura et al[6]**
1. Eligibility criteria specified (yes/no; not included in overall score)	No	No	Yes
2. Subjects randomly allocated to groups (yes/no)	Yes	Yes	Yes
3. Allocation was concealed (yes/no)	No	Yes	No
4. Groups similar at baseline (yes/no)	No	Yes	Yes
5. Subjects were blinded to group (yes/no)	No	No	No
6. Therapists who administered therapy were blinded (yes/no)	No	No	No
7. Assessors were blinded (yes/no)	Yes	No	Yes
8. Minimum 85% follow-up (yes/no)	No	No	No
9. Intent to treat analysis for at least 1 key variable (yes/no)	No	No	No
10. Results of statistical analysis between groups reported (yes/no)	Yes	Yes	Yes
11. Point measurements and variability reported (yes/no)	No	Yes	Yes
Overall Score (out of 10)	3/10	5/10	5/10

Table 4.2: Characteristics of Included Studies

Authors	**Davis et al[5]**	**Lim et al[10]**	**Puentedura et al[6]**
Title	The Effectiveness of 3 Stretching Techniques on Hamstring Flexibility using Consistent Stretching Parameters	Effects on Hamstring Muscle Extensibility, Muscle Activity, and Balance of Different Stretching Techniques	Immediate effects of quantified hamstring stretching: Hold-relax proprioceptive neuromuscular facilitation versus static stretching
Study Design	Randomized controlled trial	Randomized controlled trial	Comparative study
Participants	19 subjects (11 males, 8 female) ages 23.1±1.5, range 21-35 years	48 Adult males, age range 20-30; static stretch (n=16) 22.25±2.29, PNF (n=16) 23.50±2.16, and control (n=16) 22.38±2.31	30 subjects (17 male / 13 female) mean age 25.7±3.0, range 22-17 years
Inclusion and Exclusion Criteria	Inclusion: Tight hamstring as defined by a 20° Knee Extension Angle (KEA) with the hip in 90° of hip flexion; between 18 and 40 years of age. Exclusion: Previous history of lower-extremity pathology, which may adversely affect hamstring flexibility length.	Inclusion: Male adults in their 20s and 30s; Extensibility of hamstring muscle reduced by 20° as measured by the Active Knee Extension (AKE) Test. Exclusion: History of injury which could have affected hamstring muscle extensibility: herniated intervertebral disk, cruciate ligament damage, femoral muscle or hamstring muscle damage, sciatic neuralgia, etc. as well as dose who were or a history of surgery nervous or musculoskeletal systems, within the last 5 years, currently engaged in exercises such as stretching, yoga, Pilates, etc. for improving flexibility.	Inclusion: Not listed Exclusion: (possible) pregnancy, hamstring injury within the past year, exceeding 80° in the initial Active Knee Extension (AKE) test, and/or participation in sports that required regular hamstring stretching.
Interventions Investigated	Group 1 (active self-stretch): Supine, hip actively flexed to 90°, knee actively extended for 30 seconds, repeated bi-laterally; 3 x per week, 4 weeks Group 2 (manual static stretch): Supine, Passive Knee Extension (PKE)'point of strong but tolerable stretch,' 30 second hold; repeated bi-laterally; 3 x per week, 4 weeks Group 3 (Proprioception Neuromuscular Facilitation (PNF)-Reciprocal Inhibition):	Static Stretch Group: Supine, Passive Straight Leg Raise (PSLR) - 1 set of 30 second PNF Stretch Group: Hold-Relax Technique – Supine with PSLR, then 6 second contraction of hamstring, leg then lowered to table for 5 seconds repeated for total of 3 sets Control Group: No intervention specified	Static Stretch (SS) Group: 2 sets of 30 second stretches, 10 second rest interval between PNF Stretch Group: Hold-Relax Technique – Supine with leg raised to end range, 4 sets of 10 second isometric contraction with 10 second passive stretch intervals

	Supine, PKE to 'point of strong but tolerable stretch', 10 second knee extension contraction; reposition to new 'point of strong but tolerable stretch' and 30 second hold; repeated bi-laterally; 3 x per week, 4 weeks Group 4 (control): No intervention		Stretching interventions were applied using a custom pulley-weight system (weight proportional to 5% of subjects body mass and discomfort rating mean of 8.29 PNF, 8.06 SS)
Outcome Measures	Range of Motion (ROM) using Knee Extension Angle	ROM using Active Knee Extension (AKE) Maximum voluntary isometric contraction using surface electromyography Static Balance using force measuring plate	ROM using AKE
Main Findings	At week 2, no significant increase of ROM in all four groups compared to control group. Static stretch showed significant increase over baseline. At week 4, all three treatment groups show an increase of ROM over baselines, but only static stretch had significant increase over control group from baseline (Static Stretch: Mean Difference 23.7°, Control Group: Mean Difference 3.2°). Achieved a *MCID. Significant interaction between intervention and length of program ($p < .0016$)	Significant increase of ROM in both stretching groups ($p < 0.05$) compared to control No significant difference between stretching interventions. (Static Stretch: Mean Difference 9.62°, PNF Stretch: Mean Difference 11.87°) Achieved a *MCID. No significant differences in muscle activation or balance between groups.	Significant increase of ROM compared to control condition (PNF/Control $p < .0005$; SS/Control $p = .011$) No significant difference between stretching interventions. (PNF: Mean Difference 8.9°±7.7, Static: Mean Difference 9.1°±8.9, Control: Mean Difference 1.5°±9.3) Achieved a *MCID.
Level of Evidence	1b	1b	2b
Validity Score	PEDro 3/10	PEDro 5/10	PEDro 5/10
Conclusion	Static stretching was more effective than PNF stretching in individuals presenting with hamstring tightness.	Both static and PNF stretching are effective at increasing range of motion in individuals presenting with hamstring tightness.	Both static and PNF stretching are effective at increasing range of motion in individuals presenting with hamstring tightness.

***The Minimal Clinically Important Difference (MCID) is a difference of 5 degrees.*[19]**

4.2: Changes in Hamstring Range of Motion Following Neurodynamic Sciatic Sliders: A Critically Appraised Topic

Accepted for Publication in the in Journal of Sport Rehabilitation in December, 2015

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Eric Stanford, and Alli Zeigel

Clinical Scenario

Hamstring tightness (HT), a common condition across all age groups[1], has classically been thought to be caused by a reduction in tissue length leading to muscular strain and dysfunctional or restricted movement. Traditionally, HT has been addressed via static, dynamic, and proprioceptive neuromuscular facilitation (PNF) stretching techniques aimed at increasing range of motion (ROM) by treating what is assumed to be a tissue length issue in the hamstring muscle group.[2] Recently, researchers have questioned the efficacy of stretching as a treatment method for increasing ROM compared to other techniques.[3] Neurodynamic Sliding (NDS) integrates both the musculoskeletal and nervous systems through a "flossing" of the nerves to achieve pain reduction or increased ROM in the extremities.[4] The use of NDS has recently been proposed as an alternative to stretching for patients with HT by addressing the neural factors of tightness without stretching the hamstring muscle tissue.[5,6,7] Several recent studies have examined the effectiveness of stretching compared to NDS.[5,6,7] Therefore, examining the evidence for NDS interventions versus traditional stretching techniques may offer more insight into practical clinical techniques for addressing patients with HT.

Focused Clinical Question

In an active population, what is the effect of using NDS compared to static or PNF stretching on traditional measures of hamstring ROM?

Summary of Search, Best Evidence Appraised, and Key Findings

- The literature search identified 6 studies. Of the 6 studies, one study was excluded as a duplicate study, two studies were excluded based on their title or abstract, and no studies were excluded based on lack of relevance to the critically appraised topic (CAT) (Figure 4.2).
- Two randomized controlled trials (RCT) and one comparative study met the inclusion and exclusion criteria (Table 4.3).
- All studies compared NDS targeting the sciatic nerve to stretching, with hamstring ROM measurements as a primary outcome measure. Both PNF[5] and static[6,7] stretching were included as comparisons.
- In the included studies, all researchers agreed that NDS targeting the sciatic nerve resulted in significant gains in ROM; however, only one group of researchers[6] reported NDS to be more effective than stretching. The double-blinded RCT had a large sample size and was the highest quality study included in the CAT,[6] according to the Physiotherapy Evidence Database (PEDro) scale.
- The authors of this CAT independently completed the PEDro scale and a consensus was obtained and determined for each article. The average score for included articles was 5/10.

Clinical Bottom Line

Evidence exists to support the use of NDS to increase measures of hamstring ROM in participants who present with limited hamstring flexibility; however, the effectiveness of NDS compared to traditional stretching is inconclusive. The authors of one of the three studies[6] demonstrated NDS was more effective than static stretching at increasing hamstring ROM measurements, while the authors of a second study[7] reported no difference between NDS and static stretching. The authors of the third study[5] evaluated in the CAT reported PNF stretching was superior to NDS at increasing hamstring ROM.

Strength of Recommendation

Grade B evidence exists that NDS performs as well as traditional stretching techniques at increasing measures of hamstring ROM on participants with limited hamstring flexibility. The Strength of Recommendation Taxonomy[8] recommends a grade of B for inconsistent Level 1 evidence or Level 2 evidence.

Search Strategy

A computerized search was completed in April 2015 (Figure 4.2).

Terms Used to Guide Search Strategy

- **P**atient/ Client group: hamstring tightness; hamstring
- **I**ntervention/Assessment: neurodynamic or slider or sciatic*
- **C**omparison: static stretching; PNF stretching
- **O**utcome: flexibility or range of motion

Sources of Evidence Searched

- CINAHL Plus
- Health Source
- MEDLINE
- SPORTDiscus
- Additional references obtained via reference list review and hand search

Inclusion Criteria

- Limited to studies that compare NDS targeting the sciatic nerve to stretching

Excluded studies based on criteria

- Trampas A, Kitsios A, Sykaras E, Symeonidis S, Lazarou L. Clinical massage and modified proprioceptive neuromuscular facilitation stretching in males with latent myofascial trigger points. *Physical Therapy in Sport*. 2010;11(3):91-98.

- Szlezak AM, Georgilopoulous P, Bullock-Saxton JE, Steele MC. The immediate effect of unilateral lumbar Z-joint mobilization on posterior chain neurodynamics: A randomized controlled study. *Manual Therapy*. 2011;16(6):609-613.

- Limited to articles written in the English language
- Limited to articles written in the last 10 years (2006-2015)
- Limited to humans

Exclusion Criteria

- Studies that used minors as participants
- Studies that used an injured population as participants
- Studies that used sciatic tensioners instead of sciatic sliders
- Studies that combined sciatic sliders with stretching as treatment
- Studies that did not include pre- and post-treatment mean range of motion outcomes

Results of Search

Three relevant studies were located using the above search terms (Table 4.3). Validity of the selected studies was identified using the PEDro scale (Tables 4.4 & 4.5). Each author independently reviewed the studies and completed the checklist. All authors met to determine agreement for each item on the checklist.

Best Evidence

As described in Table 4.3, the studies selected for inclusion in this CAT were identified as the best evidence. The authors of these level 2 or higher studies considered the use of NDS targeting the sciatic nerve on traditional measures of ROM in comparison to traditional stretching.

Implications for Practice, Education and Future Research

The studies included in this CAT were conducted to identify the effect of NDS targeting the sciatic nerve compared to stretching on hamstring ROM measures in a healthy population. In regards to the indications for use of NDS for the treatment of HT, heightened neural mechanosensitivity may cause pathomechanical dysfunction, such as muscular tightness.[4] The "tightness" reported by the patient may be based on a perception of tightness, rather than a tissue length issue.[9] Addressing the neural component within the muscle tissue may result in increased measures of ROM.[4] Therefore, NDS s have been offered as a method to increase ROM compared to traditional stretching within rehabilitation programs.

The researchers of the three studies examined in this CAT identified NDS to be effective as a stand-alone treatment; however, the efficacy of using sciatic sliders compared to stretching in the treatment of hamstring tightness is inconclusive. In the highest quality study[6] available, researchers randomized 120 individuals with bilateral complaints of HT and decreased ROM on the passive straight leg raise test (PSLR). Following statistical analysis, the researchers reported that the use of NDS was more effective at increasing ROM than stretching, and that both NDS and stretching were more effective at increasing ROM than a placebo group.[6] The findings were in contrast to those of researchers who conducted less rigorous studies[5,7] and found there was either no difference[7] or that stretching was more effective than NDS in the treatment of participants with apparent HT.[5] The researchers[5,6,7] who compared NDS directly to stretching, however, have not utilized consistent methodologies, which makes it difficult to assess outcomes across the limited evidence available. For example, when evaluating the three studies included in this CAT, three of the primary inconsistencies are variations in the method of assessment, application of the stretching intervention, and the application of NDS sliders.

The assessment methodology differed between the three studies. The active knee extension (AKE) was the method of assessment in one study[5] while the PSLR was utilized in the other studies[6,7] included in this CAT. The methodological discrepancies in assessment of hip flexion angle and knee extension angle are important, because they are two methods that are commonly thought to represent HT. The tension of the hamstring musculature may be a limiting factor for both the AKE and PSLR, and may differ between passive and active motions, possibly translating to differences in effectiveness of the treatment intervention between the studies.

In addition to assessment type, the number of treatment sessions and type of intervention differed between the studies. Some researchers found that a single application of NDS was more effective at increasing ROM than static stretching[6] while others determined both NDS and static stretching significantly increased ROM equally following three sessions over a one week period.[7] Another group of researchers also used three treatment sessions, but had participants perform hold-relax PNF as the comparison treatment rather than static stretching.[5] The researchers determined that both PNF and NDS interventions were effective at increasing ROM; however, the PNF stretching demonstrated greater efficacy.

The last inconsistency in the studies is observed in the difference between the applications of the NDS treatment. In the application of NDS, two researchers[5,7] used a seated position while the third[6] used a supine position. Similarly conflicting, overpressure was only used in one study,[5] possibly contributing towards the differences identified between NDS and PNF treatments. Lastly, each of the three researchers also chose to mobilize different joints within their sciatic slider treatments. Mobilizing different joints may affect the amount of nerve excursion, possibly affecting the treatment outcome.[10]

Clinicians should use caution when interpreting these results in an injured population as all three of the studies used subjects categorized with HT but who were otherwise apparently healthy. Based on the studies examined in this CAT, additional high quality studies are needed to determine the effects of NDS sciatic sliders on ROM measures in various populations. Injured populations (such as those with altered nervous system function) should be examined to determine their response to NDS treatments. Future researchers should identify the most effective NDS protocol for increasing ROM. Further, the researchers should identify the immediate, short and long-term effects of the intervention. The current CAT should be reviewed in two years to identify whether additional evidence exists that may alter the clinical bottom line of this clinical question.

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Figure 4.2: Search strategy

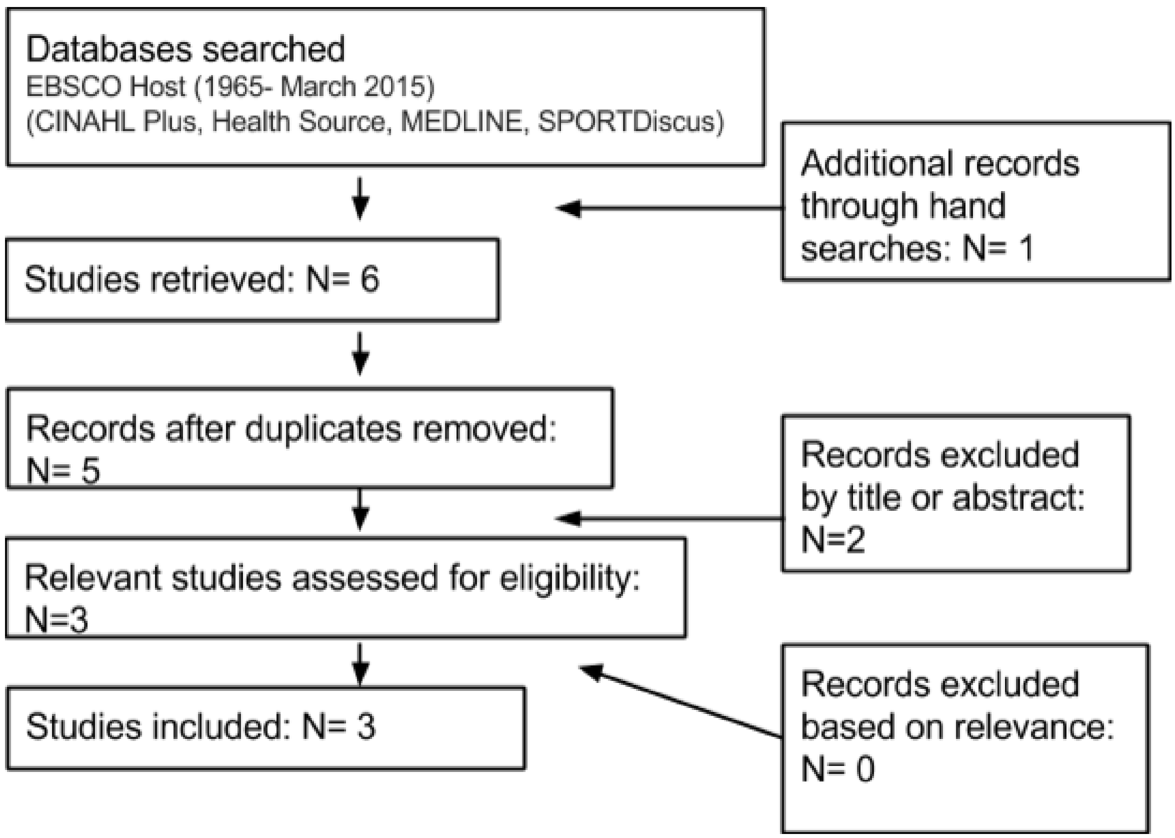


Table 4.3: Summary of Study Designs of Articles Retrieved

Level of evidence	Study design	Number located	Reference
1b	Randomized, double-blinded controlled trial	1	Castellote-Caballero et al[6]
2b	Randomized, controlled trial	1	Pagare VK et al[7]
	Comparative Study	1	Vidhi et al[5]

Table 4.4: Characteristics of Included Studies

	Castellote-Caballero et al[6]	**Pagare VK et al[7]**	**Vidhi et al[5]**
Study Design	Randomized, double-blinded controlled trial	Randomized, controlled trial	Comparative study
Participants	120 patients (60 female, 60 male; mean age 33.4 ± 7.4, range 20–45 years) with decreased PSLR ROM, otherwise apparently healthy.	30 male football players (NDS group 20.87 ± 2.89; stretch group 22.47 ± 2.48 years) with decreased PSLR ROM, otherwise apparently healthy.	60 patients (mixed males and females – number not specified) with decreased AKE ROM, otherwise apparently healthy.
Interventions Investigated	NDS Group: Supine with neck/thoracic flexion. Hip/knee flexion alternated with hip/knee extension. Perform for 180 seconds. Stretching Group: Supine, PSLR hamstring stretch. Perform 5x30 seconds. Placebo Group: Supine with passive intrinsic foot joint mobilization.	NDS Group: Seated slump position (no overpressure) with active cervical and knee flexion/ankle plantarflexion alternated with cervical and knee extension/ankle dorsiflexion. Perform 5x60 seconds with 15sec rest for three days over one week period. Stretching Group: Modified hurdler's position with flexion at hip. Hold for 30sec three days over one week period.	NDS Group: Seated slump position (overpressure by clinician) with passive knee extension/ankle dorsiflexion alternated with knee flexion. Perform 3x30 reps on 3 consecutive days Stretching Group Hold-relax PNF (Supine with 10sec stretch, 6sec static hold/contract, 30sec stretch). Perform 3 reps on 3 consecutive days
Outcome Measures	ROM using PSLR test	ROM using PSLR	ROM using AKE
Main Findings	Significant improvement in ROM in NDS and stretching groups compared to placebo ($p<0.001$). NDS group significantly greater improvements than stretching group ($p=0.006$)	Significant improvement in ROM in both groups ($p<0.001$). No difference between groups ($p=0.057$).	Significant improvement in ROM in both groups (p-value not reported). Stretching group significantly greater improvements than NDS group ($p=0.0435$).
Level of Evidence	1b	2b	2b
Validity Score	PEDro 7/10	PEDro 4/10	PEDro 4/10
Conclusion	Both static stretching and neurodynamics were effective, with neurodynamic treatment being the most effective method to increase range of motion.	Range of motion improvements were not different between groups.	Both PNF stretching and neurodynamics were effective, with PNF stretching being the most effective method to increase range of motion.

Abbreviations: PSLR, Passive Straight Leg Raise; AKE, Active Knee Extension; ROM, Range of Motion; PNF, Proprioceptive Neuromuscular Facilitation; NDS; Neurodynamic Sliders .

Table 4.5: Results of PEDro scale for each article

	Castellote-Caballero et al[6]	**Pagare et al[7]**	**Vidhi et al[5]**
1. Eligibility criteria specified (yes/no)	Yes	Yes	Yes
2. Subjects randomly allocated to groups (yes/no)	Yes	Yes	Yes
3. Allocation was concealed (yes/no)	Yes	Yes	No
4. Groups similar at baseline (yes/no)	Yes	Yes	Yes
5. Subjects were blinded to group (yes/no)	Yes	No	No
6. Therapists who administered therapy were blinded (yes/no)	No	No	No
7. Assessors were blinded (yes/no)	Yes	No	No
8. Minimum 85% follow-up (yes/no)	No	No	No
9. Intent to treat analysis for at least 1 key variable (yes/no)	No	No	No
10. Results of statistical analysis between groups reported (yes/no)	Yes	Yes	Yes
11. Point measurements and variability reported (yes/no)	Yes	No	Yes
Overall Score (out of 10)	7/10	4/10	4/10

Item 1 not included in overall score

CHAPTER 5

APPLIED CLINICAL RESEARCH

Hamstring Extensibility Following Total Motion Release® Forward Flexion Trunk Twist Versus Sham Treatment

(Plan is to submit to the *Journal of Athletic Training)*

Key points:

- Traditional evaluation and treatment techniques of apparent hamstring tightness (AHT) fail to consider alternative causative factors, such as neural drive or fascial restriction, when addressing movement dysfunction.
- The Total Motion Release® (TMR®) forward flexion trunk twist (FFTT) may effectively address the underlying neural or fascial causes of AHT by utilizing multi-planar movement at the trunk and lumbopelvic complex.
- Participants categorized with AHT significantly improved on measures of ROM immediately after a single treatment of the TMR® FFTT compared to a sham group.

Multisite research partners: Bobby Bonser, Christy Hancock, Bethany Hansberger, Rick Loutsch, Eric Stanford, Alli Zeigel

Abstract

Context: Hamstring tightness is a common condition typically treated by stretching interventions. Limited evidence exists to support the use of the Total Motion Release® (TMR®) forward flexion trunk twist (FFTT) as a holistic approach to resolving hamstring tightness.

Objective: To assess the immediate and short-term effects of the TMR® FFTT on measures of hamstring extensibility.

Design: Multisite randomized controlled clinical trial.

Setting: University athletic training clinics.

Patients or Other Participants: Sixty (34 male, 26 female) healthy, physically active individuals presenting with signs of AHT.

Intervention(s): Participants were randomized into one of two groups: (a) treatment (TMR® FFTT) group or (b) sham group.

Main Outcome Measure(s): Hamstring ROM was assessed using the active knee extension (AKE), passive straight leg raise (PSLR), finger to floor distance (FFD), and v-sit and reach (VSR) tests. All measures were performed at baseline, immediately post-treatment, and at one day follow-up. Repeated measures ANOVAs were utilized to assess both within group and between groups differences. Holm's sequential Bonferroni corrections were performed to determine differences between groups. Statistical significance was considered at $p<.05$

Results: The TMR® FFTT group demonstrated significantly more improvement in ROM than the sham group immediately post-treatment for the AKE-Most Restricted (MR) (6.4° ± 4.8° vs. 2.7° ± 6.6°, $p = 0.018$, Cohen's d = 0.65, 95% CIs: 0.66°, 6.8°), PSLR-MR (5.8° ± 4.2° vs. 2.2° ± 4.5°, $p = 0.002$, Cohen's d = 0.85, 95% CIs: 1.7°, 6.4°), FFD (4.6cm ± 3.4cm vs. 2.0cm ± 4.1cm, $p = 0.01$, Cohen's d = 0.73, 95% CIs: 0.67cm, 4.7cm), and VSR (4.4cm ± 3.1cm vs. 1.7cm ± 2.9cm, $p = 0.001$, Cohen's d = 0.92, 95% CIs: 0.93cm, 4.0cm). No between-group differences were found at the one day follow-up.

Conclusions: The TMR® FFTT effectively increased ROM on measures of hamstring extensibility immediately following a single intervention compared to a sham treatment that consisted of a sub-optimal form of static stretching. In an effort to promote clinical relevance and increase external validity, the methodology of the study featured materials and methods readily available in athletic training clinics; however, limitations of the study may have hindered the magnitude of effect identified in the results. Future researchers should consider more stringent inclusion criteria and the response of various ROM measures following TMR® FFTT treatment. **Key Words:** Regional interdependence, hamstring, tightness, stretching

Introduction

Hamstring tightness, commonly defined as a lack of hip flexion range of motion (ROM) with a concomitant feeling of restriction in the posterior thigh, has been documented across all age groups as a potential problem leading to dysfunctional or restricted movement.[1–9] The term hamstring tightness denotes that a lack of hip flexion or knee extension ROM is due to a tissue length deficit; however, researchers have drawn attention to multiple causal factors such as neural tension,[10–13] fascial restriction,[14] lumbopelvic dysfunction,[15,16] and/or joint or tissue length restrictions[17–20] that may contribute to this lack of ROM or tissue extensibility. Thus, the term apparent hamstring tightness (AHT) may be a better descriptor of the hamstring tightness phenomenon because the underlying cause may not be related to tissue length, and immediate gains in hamstring extensibility may be experienced following an intervention that does not address a tissue length deficit.

Tissue length deficits have been proposed to result from deformation in the elastic or plastic regions of connective tissue, leading to restricted joint motion.[19,21,22] Traditionally, AHT has been assessed using tests thought to measure the length of the hamstring muscle tissue, such as the active knee extension (AKE),[10,23–26] passive straight leg raise (PSLR),[27–31] finger to floor distance (FFD),[32] and sit and reach (SR)[33] tests. Likewise, treatment techniques commonly used for AHT were focused directly on muscle tissue (e.g., length changes) and include static, proprioceptive neuromuscular facilitation (PNF), and dynamic stretching.[34,35] Researchers have postulated that a stretching intervention may change tissue length due to the properties of viscoelastic deformation, plastic deformation, sarcomere adaptation, and neuromuscular relaxation.[21,22] The variance in repetitions, frequency, and duration of stretch protocols has led to inconsistent efficacy throughout the literature,[36–38] resulting in a lack of consensus regarding the most effective stretching protocol.

In light of the questionable efficacy and appropriateness of stretching to treat AHT, clinicians have been encouraged to rethink the classical approach to addressing AHT and consider factors other than tissue length deficits that may contribute to the perceived tightness.[39] Researchers examining alternative treatments involving more comprehensive movement patterns and lumbopelvic exercises have demonstrated promising results for increased knee ROM[40] and prevention of recurrent hamstring strain.[16] One novel technique that has yet to be studied extensively is Total Motion Release® (TMR®), a treatment philosophy based on regional interdependence in which the clinician assesses and treats imbalances throughout the body.

The regional interdependence theory is the idea that dysfunction or pain perceived in one area of the body may be influenced by a dysfunction or restriction in the neural, musculoskeletal, or fascial systems, amongst others.[41,42] A specific TMR® intervention, the TMR® forward flexion trunk twist (FFTT), has been proposed to treat AHT.[43,44] While the TMR® FFTT lacks a direct focus on lengthening hamstring musculature, improvements in both active hip flexion and knee extension ROM have been demonstrated after performing the technique.[44] Despite the paucity of research conducted on the TMR® FFTT, the technique may be a beneficial intervention for patients categorized with AHT. Therefore, the purpose of this study was to assess the immediate and short-term effects of the TMR® FFTT compared to a sham group on measures of hamstring ROM among healthy, physically active individuals presenting with signs and symptoms of AHT.

Methods

Participants

Participants were recruited from five different research sites across the country [athletic training clinics and student bodies at universities (2 NCAA Division I, 1 NCAA Division II, 1 NCAA Division III, and 1 NAIA)]. Physically active was defined as performing physical activity for at least 150 minutes a week or an average of 30 minutes a day five days per week.[35] Participants were active in a variety of settings (36 intercollegiate, 22 recreational, and 2 club sports) with the most common sports after recreational activity (22) being soccer (9), baseball (6), and track/field (6). A total of 70 physically active individuals (35 men: 20.8 ± 1.7 years; 35 women: 20.4 ± 1.4 years) volunteered to participate in this multisite research study and were screened for the following inclusion criteria: AKE angle of at least 20°, a TMR® FFTT asymmetry of at least 5 points, and a score of at least 1 on the Perceived Tightness Scale (PTS). The AKE was performed bilaterally and the leg with the most restricted motion was identified as the “most restricted” (MR) leg for ROM measurements throughout the study.

The following exclusion criteria were applied: (1) lower extremity injury in the previous six weeks; (2) lumbar pathology including back injury in the previous six weeks, known lumbar spine pathology limiting ROM (e.g., discogenic), prior lumbar spine surgical procedures, known lumbosacral spine physical impairments limiting ROM and function; (3) lower extremity surgery within last six months; major ligamentous surgery within last one year; (4) vestibulocochlear disturbances/concussion (5) joint hypermobility syndrome (Beighton Score of four or higher); (6) connective tissue disorders (e.g., Marfans, Ehlos Danlos); or (7) lower extremity neurovascular pathology, including numbness, tingling, and loss of sensation. A total of 10 participants were excluded from the study. One participant did not meet the physically active requirement; two participants had bilateral AKE angle measurements of less than 20°; five participants did not have a TMR® FFTT asymmetry; one participant reported low back pain; and one participant reported a lower extremity injury in the prior six weeks.

In total, 60 participants met the inclusion/exclusion criteria; 30 were randomly assigned to the TMR® FFTT group (20.7 ± 1.7 years; 42.3° ± 7.9° AKE-MR; 35.3 ± 20.1 TMR® asymmetry) and the other 30 were assigned to the sham group (20.6 ± 1.5 years; 45.1° ± 10.1° AKE-MR; 27.6 ± 17.8 TMR® asymmetry) (Table 5.1). Dropout criteria determined *a priori* included pain that developed during treatment; verbal request by participant to discontinue the study; and non-compliance (i.e., failure to return for one-day follow-up testing). Based on these criteria, two of the 60 participants dropped out of the study due to pain during the treatment (1) and noncompliance (1), leaving a total of 58 participants (TMR® FFTT = 28, sham = 30) who completed all stages of the study.

Prior to beginning the study, the research procedures were explained to each participant. All participants provided written consent to participate in this study and the study was approved by the Institutional Review Board of XXXXXX along with the Institutional Review Board at each of the five research sites.

Experimental Procedures

The principal investigators (n = 5) administered all ROM measurements and interventions at their respective sites. Prior to initiating the study, the clinicians completed the TMR® training courses and conducted a pilot study to validate their methods and establish consistency of treatments and measurements. To ensure measurement reliability amongst all clinicians participating in this multisite research study, the intra-rater and inter-rater reliabilities of the AKE, PSLR, FFD, and v-sit and reach (VSR) were assessed prior to beginning this study. All measurements had high intra-rater and inter-rater reliability assessed with Intraclass Correlation Coefficients (ICC) (3,1), with absolute agreement (Table 5.2).[45] The high reliability was consistent with the intra- and inter-rater values reported in the literature for the AKE,[23,31,46,47] PSLR,[46,48] FFD,[32] and VSR.[49] The standard error of measurement (SEM) and minimal detectable change (MDC) values were also calculated for each dependent variable from the reliability testing data performed prior to this study (Table 5.2). Standard measurement error was derived using the interrater ICC and the following formula: SEM=SD × √((1)-ICC).[50] Minimum detectable change for this study was subsequently calculated using the formula MDC=1.96 × √2 × SEM (Tables 5.2 - 5.3).[50]

Group allocation of the participants was concealed from the clinician until after baseline measurements were taken, at which point group assignment was revealed by opening a sealed, opaque envelope containing the participant's group assignment. All baseline measurements were performed in a pre-determined, randomized order using a random number generator (random.org) without a rest period between measurements. After baseline measurements, participants completed the treatment intervention according to their group assignment. Following the intervention, immediate post-treatment and one day follow-up measurements were recorded in the same order as baseline measures.

Total Motion Release® (TMR®) Forward Flexion Trunk Twist (FFTT) Treatment

The TMR® FFTT treatment intervention began with a screening procedure by having the participant stand with feet together and arms crossed in front of the chest. The participant was instructed to flex forward at the waist into a neutral position or just prior to the point of discomfort (Figure 5.1a) and then twist to the right, return to the neutral position and then twist to the left. The participant was shown a TMR® grading scale (0-100) in which a score of zero equals “no problems at all” and a score of 100 equals “the worst” in regards to how the motion felt (i.e., pain, tightness, ROM, strength, tension, nervousness, and quality). The participant was asked to score the difference between twisting to the right versus twisting to the left by identifying a difficult side and indicating a percent difference between the difficult and easy sides. For the feet apart position, the participant was asked to stand with feet apart, flex forward at the waist over the right leg (Figure 5.2a), return to the starting position, and then flex forward at the waist over the left leg noting which leg “felt better” to flex forward over (i.e., the good leg). Following this, the participant forward flexed at the waist over the leg that “felt worse” and twisted towards midline, returned to the neutral position over the “bad leg,” and then twisted away from midline. The participant then identified which direction was more difficult and scored the motion in the same way as described above for the feet together position.

Following the screening procedure, each participant in the TMR® FFTT group performed two sets of 10 repetitions of the feet together FFTT to the side previously identified as the “easy side” during the screening procedure.[44,51] After twisting, the participants were instructed to slowly release anything felt to be preventing further movement (e.g., bending the knee, extending the trunk, looking over the shoulder) which would allow for further twisting motion with each repetition (Figure 5.1b). The participant was given 30 seconds to rest between sets. Following the TMR® FFTT treatment with feet together, the participant repeated the same procedure with feet apart, twisting in the "more difficult" direction over the good leg, as identified in the screening procedure (Figure 5.2b).[51] The participant performed two sets of 10 repetitions in the feet apart position with the same "twist and then release" instructions provided. Immediately following the TMR® FFTT treatment, all participants completed post-treatment measurements.

Sham Treatment

The sham treatment required each participant to maintain a position of forward trunk flexion, without the twisting motion present in the TMR® FFTT, simulating a position often utilized in static stretching. Each participant randomized into the sham treatment group was instructed to stand with the feet together and arms crossed in front of the chest. The participant was then instructed to forward flex at the waist to approximately 90° or just prior to the point of discomfort to ensure that maximal, end-range stretching was avoided (Figure 5.1a). Each participant held this position for 30 seconds and then returned to the starting position. A total of four repetitions with 30 second holds were performed and 30 seconds of rest was provided between each repetition. Immediately following the sham treatment, all participants completed post-treatment measurements.

Range of Motion Measurement Methods

An inclinometer application (Clinometer, https://www.plaincode.com/products/clinometer/) was installed on an iPhone or Android smartphone device by each researcher. The Clinometer application was utilized to collect the AKE and PSLR measures and was calibrated before each participant's arrival. While not utilized in the lower extremity literature, the Clinometer application has been found to be reliable for measuring shoulder ROM [ICC (2,1) = .8].[52] Prior to collecting ROM measurements, a mark was placed on the anterior tibia (three inches below the tibial tuberosity) and on the anterior thigh (six inches above the tibial tuberosity) of each leg for all participants to ensure accurate and consistent placement of the smartphone for use of the Clinometer app. A cloth tape measure was used for the FFD and VSR tests. For all tests requiring unilateral measurements (AKE, PSLR), the right leg was assessed first, followed by the left leg. A total of three measurements were taken for all tests and the average of the three was reported, with the exception of the VSR, in which the third measure stood as the final score.[53]

Active Knee Extension (AKE) Measurement

The AKE was measured by the clinician with the participant in a supine position with one leg in a 90-90 position as an assistant stabilized the contralateral leg in an extended position (Figure 5.3a). The clinician placed one hand on the posterior thigh four inches superior to the knee while the other hand placed the smartphone inclinometer on the participant's anterior thigh with the top of the phone in line with the marking on the participant's thigh to assess maintenance of 90-degree positioning. The participant was then instructed to actively extend the knee to the point of discomfort, while maintaining 90 degrees of hip flexion. When the participant reached the point of discomfort (i.e., an uncomfortable amount of tension),[54] the clinician relocated the smartphone inclinometer from the anterior thigh to the mark at the mid-anterior tibia, making sure to keep the other hand on the posterior thigh to maintain 90 degrees of hip flexion (Figure 5.3b).

Passive Straight Leg Raise (PSLR) Measurement

The PSLR was measured by the clinician as the participant lay supine with the legs extended. The clinician passively flexed the participant's hip while maintaining knee extension and monitoring for pelvic rotation until the point of discomfort was reached. An assistant stabilized the contralateral leg in an extended position during the procedure (Figure 5.4). The ROM measurement was recorded with the smartphone inclinometer placed at the mark on the thigh.

Finger to Floor Distance (FFD) Measurement

The FFD test was performed with the participant standing on a 20 cm box with the feet together and the toes positioned at the edge of the box. The participant flexed at the waist with hands on top of one another, reaching for the toes, and stopping at the point of discomfort (Figure 5.5). The clinician visually ensured the participant's knees did not flex while performing the movement. The clinician measured from the top edge of the box to the tip of the middle finger of the top hand in centimeters. A measurement of "0" indicated the fingertip was in line with the edge of the box. A positive number indicated that the fingers had not reached the edge of the box, while a negative number indicated the fingers were past the edge of the box. Measurements were rounded to the nearest half centimeter.

V-Sit and Reach (VSR) Measurement

A cloth tape measure was affixed to the floor using pieces of tape to assess the participant's ROM. A piece of tape denoting the baseline "zero" point was placed at the 40 cm mark of the cloth tape measure. On the baseline tape strip, two marks were placed 15 cm on either side of the tape measure to denote the spot where the participant's feet would be placed (Figure 5.6).

The participant was instructed to sit on the floor with the legs extended, the feet spaced 30 cm apart, and the plantar surface of the feet touching a box to keep the ankle joints in a neutral position.[53] An assistant stabilized one leg on the floor in an extended position, while the clinician stabilized the other leg. The participant placed one hand over top of the other and flexed at the waist towards the toes to the point of discomfort. The motion was performed three times and the measurement was taken on the third attempt. The clinician measured from the edge of the baseline "zero" tape line to the tip of the middle finger. A measurement of "0" indicated the fingertip was in line with the edge of the baseline "zero" tape line. A negative number indicated that the fingers had not reached the edge of the line, while a positive number indicated the fingers were past the edge of the line. Measurements were rounded to the nearest half centimeter.

Perceived Tightness Scale (PTS)

The participant's perception of tightness was identified using the Perceived Tightness Scale (PTS) which was adapted from the 0-10 numeric rating scale (NRS). The NRS is a numerical ranked scale that measures the intensity of the participant's pain;[55] however, in this study, the participants were asked to rate their amount of perceived hamstring tightness at baseline, immediately following the treatment, and at one day follow-up. On the PTS, a score of 0 indicated "no perceived tightness" and a score of 10 indicated "extreme tightness."

Data Analysis

Statistical analysis was performed using SPSS statistical software (version 23; SPSS Inc., Chicago, IL). Each dependent variable was assessed for outliers by treatment group using estimates of skewness and kurtosis, visual inspection through histograms, as well as with Levene's test and the Shapiro-Wilk test. One-way within subject repeated measures analysis of variance (RM-ANOVAs) were performed to assess the effect of the TMR® FFTT on each dependent variable over time. Bonferroni comparison testing was used for post-hoc analysis. Significance was considered to be $p \leq .05$. Between-groups effects were assessed using RM-ANOVAs for each dependent variable. Independent sample t-tests were used to assess between group differences at each time point (baseline-post treatment; baseline-one day follow-up). A Holm's sequential Bonferroni correction was performed to establish new alpha levels (i.e., .025, .05) for significant findings. Differences at baseline were assessed using independent t-tests; if a baseline difference was discovered, the variable was assessed using an independent t-test on the difference scores rather than with the RM-ANOVA. To determine the treatment effect size, the Cohen's d statistic was calculated, with small $\geq .2$, medium $\geq .5$, and large $\geq .8$.[56]

Effect size indicates the magnitude of difference between two groups, with moderate to large differences associated with increased clinical meaningfulness of the results.[56] Additionally, a conservative Holm's sequential Bonferroni adjustment results in a decreased risk of Type I error, but also results in low power.[57] Low statistical power is associated with an increased risk of making a Type II error.[58] Therefore, our conservative statistical choices reduce the risk of incorrectly concluding the two groups are statistically different when they actually are not, but the tests may not have the power needed to detect differences that exist.[57]

Results

Active Knee Extension (AKE) - Most Restricted (MR) Leg

There were no differences at baseline in AKE-MR measurements ($t_{(56)} = -0.93$, $p = .354$, 95% CIs: -7.0°, 2.5°) between TMR® FFTT (42.9° ± 7.7°) and sham treatment (45.1° ± 10.1°). The between-subjects time*group interaction was significant ($\lambda = 0.9$, $F_{(2,55)} = 3.21$, $p = .048$, partial eta squared = 0.1, power = 0.59) (Table 5.4). Utilizing the Holm's sequential Bonferroni adjustment for follow-up testing, there was a significant difference between TMR® FFTT (mean difference = 6.4° ± 4.8°) and sham treatment (mean difference = 2.7° ± 6.6°) immediately post-treatment ($t_{(56)} = 2.43$, $p = .018$, Cohen's d = 0.65, 95% CIs: 0.66°, 6.8°). There were no significant differences between groups at one day follow up ($t_{(56)} = 1.65$, $p = .105$, Cohen's d = 0.44, 95% CIs: -0.53°, 5.5°).

The within-subjects time main effect for the TMR® FFTT group was significant ($\lambda = 0.31$, $F_{(2,26)} = 29.11$, $p < .001$, partial eta squared = 0.69, power = 1.0) (Table 5.5). Bonferroni post-hoc testing revealed a significant increase in ROM from baseline to post-treatment (mean difference = 6.4°, SEM = 0.91°, $p < .001$) and from baseline to one day follow-up (mean difference = 5.0°, SEM = 1.1°, $p < .001$). Between time points within the TMR® FFTT group, participants maintained 79% of their post-treatment changes at the one day follow up for the AKE.

Passive Straight Leg Raise (PSLR) - Most Restricted (MR) Leg

There were no significant differences at baseline in PSLR-MR measurements ($t_{(58)} = -1.95$, $p = .056$, 95% CIs: -15.8°, 0.2°) between TMR® FFTT (51.6° ± 14.8°) and sham treatment (59.0° ± 14.1°). The between-subjects time*group interaction was significant ($\lambda = 0.85$, $F_{(2,55)} = 4.98$, $p = .01$, partial eta squared = 0.15, power = 0.79). Following the post-hoc assessment, a significant difference between TMR® FFTT (mean difference = 5.8° ± 4.2°) and sham treatment (mean difference = 2.2° ±

4.9°) was identified immediately post-treatment ($t_{(58)} = 3.2$, $p = .002$, Cohen's d = 0.85, 95% CIs: 1.6°, 6.0°). There were no significant differences between groups at one day follow up ($t_{(56)} = 1.6$, $p = .115$, Cohen's d = 0.43, 95% CIs: -0.86°, 7.7°).

The within-subjects time main effect for the TMR® FFTT group was significant ($\lambda = 0.34$, $F_{(2,26)} = 25.32$, $p < .001$, partial eta squared = 0.66, power = 1.0). Bonferroni post-hoc testing revealed a significant increase in ROM from baseline to post-treatment (mean difference = 5.8°, SEM = 0.8°, $p < .001$) and from baseline to one day follow-up (mean difference = 4.4°, SEM = 1.5°, $p = .023$). Between time points within the TMR® FFTT group, participants maintained 76% of their post-treatment changes at the one day follow up for the PSLR.

Finger to Floor Distance (FFD)

Outlier assessment revealed a skewness value of 1.11 (SE = 0.43) with a kurtosis value of 2.16 (SE = 0.83) for the sham group at baseline. Histogram, box plot, and visual inspection of the data revealed two possible outliers; data for the FFD was removed for these participants prior to further analysis. Following outlier removal, skewness for the baseline FFD was -0.199 (SE = 0.44) and kurtosis was -1.05 (SE = 0.86). There was a significant difference at baseline in FFD measurements ($t_{(56)} = 2.48$, $p = .016$, 95% CIs: 1.2cm, 11.2cm, power = 0.57) between TMR® FFTT (10.5 cm ± 10.5 cm) and sham treatment (4.3 cm ± 8.1 cm). Independent sample t-tests were used and revealed a significant difference between TMR® FFTT (4.6 ± 3.4cm) and sham treatment (2.0 ± 4.1cm) immediately post-treatment ($t_{(54)} = 2.67$, $p = .01$, Cohen's d = 0.73, 95% CIs: 0.67 cm, 4.7 cm). There were no significant differences between groups at one day follow up ($t(54) = 1.4$, $p = .155$, Cohen's d = 0.39, 95% CIs: -0.73 cm, 4.5 cm).

The within-subjects time main effect for the TMR® FFTT group was significant ($\lambda = 0.34$, $F_{(2,26)} = 25.64$, $p < .001$, partial eta squared = 0.66, power = 1.0). Bonferroni post-hoc testing revealed a significant increase in ROM from baseline to post-treatment (mean difference = 4.6 cm, SEM = 0.64

cm, $p < .001$) and from baseline to one day follow-up (mean difference = 2.9 cm, SEM = 0.87 cm, p = .008). Between time points within the TMR® FFTT group, participants maintained 63% of their post-treatment changes at the one day follow up for the FFD.

V-Sit and Reach (VSR)

There were no differences at baseline in VSR measurements ($t_{(58)} = -0.9$, p = .374, 95% CIs: -7.4 cm, 2.8 cm) between TMR® FFTT (-13.5 cm ± 11.0 cm) and sham treatment (-11.2 cm ± 8.3 cm). The between-subjects time*group interaction was significant ($\lambda = 0.81$, $F_{(2,55)} = 6.3$, p = .003, partial eta squared = 0.19, power = 0.88). Post-hoc testing using independent t-tests and a Holm's sequential Bonferroni adjustment revealed a significant difference between TMR® FFTT (4.4 cm ± 3.1 cm) and sham treatment (1.7 cm ± 2.9 cm) immediately post-treatment ($t_{(58)} = 3.45$, p = .001, Cohen's d = 0.92, 95% CIs: 1.1 cm, 4.3 cm). There were no significant differences between groups at one day follow up (t(56) = 2.0, p = .054, Cohen's d = 0.53, 95% CIs: -0.04 cm, 4.6 cm).

The within-subjects time main effect for the TMR® FFTT group was significant ($\lambda = 0.3$, $F_{(2,26)} = 31.018$, $p < .001$, partial eta squared = 0.71, power = 1.0). Bonferroni post-hoc testing revealed a significant increase in ROM from baseline to post-treatment (mean difference = -4.4 cm, SEM = 0.6 cm, $p < .001$) and from baseline to one day follow-up (mean difference = -2.2 cm, SEM = 0.6 cm, p = .005). Between time points within the TMR® FFTT group, participants maintained 49% of their post-treatment changes at the one day follow up for the VSR.

Perceived Tightness Scale (PTS)

Outlier assessment revealed no significance at baseline for either the TMR® FFTT group (Shapiro-Wilk = 0.93, p = .068) or the sham group (Shapiro-Wilk = 0.97, p = .591). The non-parametric Mann Whitney U was not significant for baseline (U = 368.5, p = .417), immediate post-treatment (U = 332, p = .162) or one day follow-up (U = 337.5, p = .194).

Discussion

In this exploratory study, the TMR® FFTT produced significant improvements in ROM on the AKE, PSLR, FFD, and VSR to a greater extent than the sham treatment immediately following a single session. No significant differences were found to suggest the TMR® FFTT had an effect on ROM measures greater than the sham treatment at a one day follow-up. Although statistically significant gains in ROM were produced, further analysis of the data highlighted the clinical meaningfulness of the results. Moderate (0.65) to large (0.92) Cohen's *d* effect sizes were identified post-treatment, suggesting the TMR® FFTT treatment was clinically relevant with a moderate to large effect on ROM immediately following treatment.

The clinical relevance of this study is also enhanced due to the methodological decisions and a focus on external validity. For example, all participants were active individuals with complaints of AHT who presented to clinicians within collegiate athletic training clinics, with each ROM measurement completed utilizing methods and materials commonly located within clinics. Additionally, the Clinometer application used to record ROM is available for both Android and iPhone users. While participants were asked not to change their activity level during the study, their outside activities were not controlled between the immediate post-treatment measurements and the one day follow-up measurements by the clinicians at any of the five research sites. Therefore, the effects of a single treatment of TMR® FFTT after one day must be interpreted with caution due to the potential for confounding variables as well as the large standard deviations associated with the baseline-one day calculations.

Although the immediate results of the TMR® FFTT were statistically significant, the gains in ROM the participants experienced were moderate by clinical standards on all measures. One explanation for why the gains in ROM were not greater may be that participants were only required to present with restricted ROM on the AKE to be included. As a result, several participants were included who did not display restrictions in ROM on the PSLR (TMR® FFTT = 2, Sham = 3), FFD

(TMR® FFTT = 7, Sham = 9), or VSR (TMR® FFTT = 4, Sham = 5). In addition, the lack of restriction in ROM on the PSLR, FFD, and VSR may have contributed to the low percentage (0%, 9.5%, and 2%, respectively) of individuals who achieved functional levels of ROM on each measure immediately following treatment. Although in this preliminary study, the TMR® FFTT demonstrated only moderate results immediately following treatment and no changes after one day, the technique has been explored in other research.

The inclusion of the TMR® FFTT as a regionally interdependent treatment for AHT is supported in the literature in the form of a case study in which the patient gained 20°-30° on the AKE after a single TMR® FFTT treatment.[44] A possible explanation for the greater gains in ROM on the AKE compared to our study is that the case described by Baker et al.[44] featured a patient with a history of lumbar spine pathology with chronic AHT symptoms (over 5 years), and a large TMR® FFTT asymmetry at initial exam. Additionally, the patient's baseline AKE measurements were 13-17° more restricted than the average baseline AKE in our study, which may contribute to the greater gain in ROM achieved on the AKE following a single treatment. Although the patient's changes in AKE ROM were different from our findings, her changes on the SR (4.9cm) were similar to our results for the VSR (4.2cm). The VSR results may be more similar to the SR as both assessments require attention not only to isolated tissue tension, but also to the lumbopelvic and thoracic movements that occur with active trunk flexion. Likewise, increases in hamstring extensibility have been demonstrated on other measures (e.g., AKE, PSLR) with the application of regionally interdependent treatments focused on joint mobility[59,60] and the nervous system.[61]

Similar to the TMR® FFTT, the Mulligan Concept and neurodynamics are treatment paradigms demonstrated to address AHT through a regionally interdependent approach. Neural tension[10,13] and lumbopelvic dysfunction may result in restricted extensibility by creating a perception of hamstring tightness. Treatment of the lumbopelvic complex through Mulligan Concept hip mobilizations with movement effectively increased ROM on the PSLR by 13°-17° in individuals classified with tight hamstrings.[59, 60] Additionally, neurodynamic sliders of the sciatic nerve have also been found to be significantly more effective (9.9° ± 2.5°, 95% CIs: 9.1°, 10.7°) than static stretching (5.5° ± 1.6°, 95% CIs: 5.0°, 6.0°, p=0.006) at improving hip flexion ROM on the PSLR.[61] Compared to the results of these studies, we observed a 5.8° increase in hip flexion ROM on the PSLR immediately following one treatment of the TMR® FFTT. Although the specific mechanism by which the TMR® FFTT affects AHT is unknown, the technique has been proposed to increase hamstring extensibility using the theories of neural coupling[62-64] and biotensegrity.[65] Aside from treatments with a holistic approach, stretching is perhaps the most common local treatment used for addressing AHT.

In several studies, static stretching of the hamstrings musculature has resulted in knee extension and hip flexion ROM gains.[24,36–38,66] DePino et al.[24] found a 5-6° improvement of knee extension ROM on the AKE after four consecutive 30-second static stretches. De Weijer et al.[66] conducted a similar study, identifying a 13° increase in extensibility on the AKE using three 30-second hamstring stretches performed following a warm-up. In addition to a warm-up, variation in methodologies between the two studies include that participants in the De Weijer group were passively stretched in an AKE test position with an adjustment made to increase the stretch if the participant became acclimated after 15 seconds, while participants in the DePino study performed active stretching in a standing position with no adjustments. The TMR® FFTT resulted in gains in ROM on the AKE that were similar to the DePino study (6.4°), but not as drastic as the De Weijer study. The methodological variation in the De Weijer study may help to explain the increased ROM compared to both the DePino study and this study, neither of which included a warm-up or passive stretch with an adjustment for stretch tolerance. Within both the DePino et al. and De Weijer et al. studies, the gains lessened as time progressed, with decreases in motion occurring three[24] to 15 minutes[66] after the cessation of the stretching intervention. The duration of static stretching effect is conflicting in the literature, with return to baseline scores ranging from shortly after treatment to more than one day following treatment. Following the cessation of the stretch intervention, only 4.5% of the extensibility gains were maintained at nine minutes,[24] compared to other reports of 59% maintained after 24 hours.[66]

Although the TMR® FFTT group had statistically significant and clinically meaningful results in comparison to the sham group, the sham group also demonstrated gains in ROM on the AKE immediately post-treatment (2.7°±6.6°) and at a one day follow-up (2.6°±5.5°). A possible explanation for the ROM gains in the sham group is that the forward flexed position may have placed a low-grade static stretch on the musculotendinous and neural structures of the posterior chain. According to the sensory theory,[22] the application of a short-duration stretching technique may perpetuate an increase in stretch tolerance, producing ROM gains over time. Despite the sham group demonstrating gains in ROM and maintaining those gains at one day follow-up, the relatively small ROM gains are within the SEM on the AKE (3.28°) and are likely not clinically meaningful.

In the current study, all participants were identified to have an asymmetry based on the TMR® FFTT evaluation, which may aid in identifying the underlying factors of AHT beyond tissue length deficits. Traditional evaluation of AHT accounts for the joint and tissue length restriction via assessments that include the AKE and PSLR, leading to treatment choices such as stretching. By incorporating a regionally interdependent approach to evaluation, such as the TMR® FFTT, clinicians may be able to more effectively classify patients and provide treatments that address alternative causal factors perpetuating AHT. Therefore, we propose that clinicians should utilize a holistic assessment that guides clinical decision making and treatment selection based on exam findings for patients with AHT.

Limitations and Future Research

Several methodological choices resulted in procedural limitations in this study, including: (a) the multi-site nature of the study, with multiple raters assessing ROM; (b) the decision to focus on a sham comparison versus a direct comparison to an established treatment; (c) no blinding of the clinician occurred in this study; (d) only the AKE was utilized as an inclusion method; (e) the outside activities of the participants were not controlled; (f) each ROM measure was assessed consecutively, with no rest in between. Other limitations include that the results of this study may not be generalized to a population outside of a healthy, young, active group of participants with restricted hamstring extensibility on an AKE assessment. As the focus of this study was on short-term efficacy of a single treatment, implications for long-term results of the TMR® FFTT, or the TMR® system, may not be derived from this study. Additionally, the clinicians providing treatment were relative novices using TMR®, practicing the paradigm for just less than two years.

Future investigators may wish to set more stringent inclusion criteria to determine a more accurate presentation of the treatment's effect on participants who present with restrictions on multiple measures of hamstring extensibility. Similarly, it may be beneficial to identify how AHT varies across the different assessment methods and how each method responds to TMR® FFTT treatment. Furthermore, future studies should be conducted to examine the most effective method of implementing the TMR® FFTT protocol (e.g., feet together or feet apart first).

Conclusion

The current study represents the preliminary exploration of the effects of the TMR® FFTT on patients with limited extensibility on the AKE. The TMR® FFTT is effective at increasing ROM on measures of hamstring extensibility immediately following a single intervention compared to a sham treatment that consisted of a sub-optimal form of static stretching. Despite the many limitations of this study, the outcomes support that the TMR® FFTT may be a promising alternative intervention to the traditional methods, however, further investigation is needed to support this hypothesis.

Table 5.1. Demographic data for included participants at baseline (N=58).

	TMR® FFTT	**Sham**
Gender	13 F, 15 M	13 F, 17 M
Age	20.8 ± 1.7	20.6 ± 1.5
AKE (most restricted leg)	42.9º ± 7.7º	45.1º ± 10.1º
TMR® Asymmetry	36.1 ± 20.2	27.8 ± 17.8
PTS Score	5.2 ± 2.0	5.8 ± 1.8
Population	17 IC, 0 CS, 11 REC	17 IC, 2 CS, 11 REC

AKE=active knee extension; PTS=Perceived Tightness Scale; TMR®=Total Motion Release®

Activity Level: IC=intercollegiate; CS=club sport; REC=recreational

Table 5.2. Inter-rater reliability data for all range of motion measurements.

Measurement	**Inter-Rater ICC**	**Inter-Rater 95% CI**	**SEM**	**MDC**
AKE	0.94	0.90, 0.97	3.28˚	9.08˚
PSLR	0.88	0.77, 0.94	6.88˚	19.07˚
FFD	0.98	0.96, 0.99	1.54 cm	4.26 cm
VSR	0.98	0.97, 0.99	1.40 cm	3.89 cm

AKE=active knee extension; CI=confidence interval; ICC=intraclass correlation coefficient; PSLR=passive straight leg raise; FFD=finger-floor distance; VSR=v-sit and reach

Table 5.3. Intra-rater reliability data for all range of motion measurements

Rater	AKE	PSLR	VSR	FFD
AZ				
ICC	0.879	0.871	0.95	0.959
SEM	4.31°	5.78°	2.33cm	1.92cm
MDC	15.02°	16.03°	6.46cm	5.31cm
BB				
ICC	0.8	0.889	0.957	0.935
SEM	5.42°	6.49°	2.18cm	2.56cm
MDC	15.02°	17.98°	6.05cm	7.11cm
BH				
ICC	0.894	0.914	0.951	0.949
SEM	4.30°	5.06°	2.28cm	2.16cm
MDC	11.92°	14.04°	6.31cm	5.98cm
CH				
ICC	0.867	0.872	0.943	0.947
SEM	4.33°	4.99°	2.47cm	2.13cm
MDC	12.01°	13.82°	6.86cm	5.89cm
RL				
ICC	0.861	0.902	0.965	0.954
SEM	4.86°	5.12°	1.88cm	2.00cm
MDC	13.47°	14.19°	5.22cm	7.11cm

AKE=active knee extension; CI=confidence interval; FFD-finger to floor distance; ICC=intraclass correlation coefficient; MDC=minimal detectable change; PSLR=passive straight leg raise; SEM=standard error of measurement; VSR=v-sit and reach

Table 5.4. Between-subjects effects of TMR® FFTT vs. sham over time.

	Pre-Post (mean difference ± SD)				Pre-One Day (mean difference ± SD)			
	TMR® FFTT	Sham	p-value	95% CI of difference	TMR® FFTT	Sham	p-value	95% CI of difference
Most restricted AKE	6.4°±4.8°	2.7°±6.6°	0.018*	0.66, 6.8	5.0°±6.0°	2.6°±5.5°	0.105	-0.53, 5.5
Most restricted PSLR	5.8°±4.2°	2.2°±4.5°	0.002*	1.4, 6.0	4.4°±8.1°	1.0°±8.1°	0.115	-0.86, 7.7
FFD	4.6±3.4 cm	2.0±4.1cm	0.010*	0.67, 4.7	2.9±4.6cm	1.0±5.1cm	0.155	-0.73, 4.5
VSR	4.4±3.1 cm	1.7±2.9cm	0.001*	1.1, 4.3	2.2±3.3cm	-0.12±5.2cm	0.054	-0.04, 4.6

*Indicates significance using Holm's sequential Bonferroni post-hoc testing.

AKE=active knee extension; CI=confidence interval; FFD=finger-floor distance; PSLR=passive straight leg raise; TMR® FFTT= Total Motion Release® forward flexion trunk twist; VSR=v-sit and reach

Table 5.5. Within-subjects effects of TMR® FFTT over time (mean ± SD).

	Baseline	Immediate Post-Treatment	One-day Follow-up
Most Restricted AKE	42.9º ± 7.7º	36.5º ± 6.8º*	37.9º ± 10.2º*
Most Restricted PSLR	51.6º ± 14.8º	57.4º ± 15.2º*	56.0º ± 13.6º*
FFD	10.5cm ± 10.5cm	5.9cm ± 8.8cm*	7.6cm ± 11.4cm*
VSR	-13.5cm ± 11.0cm	-9.1cm ± 11.0cm*	-11.4cm ± 11.4cm*^

*Significant difference from baseline (p≤0.05)

^Significant difference from immediate post-treatment (p≤0.05)

AKE=active knee extension; FFD=finger-floor distance; PSLR=passive straight leg raise; VSR=v-sit and reach

Figure 5.1. Sham treatment (A only) and TMR® FFTT feet together position (A and B).

Figure 5.2. TMR® FFTT feet apart treatment.

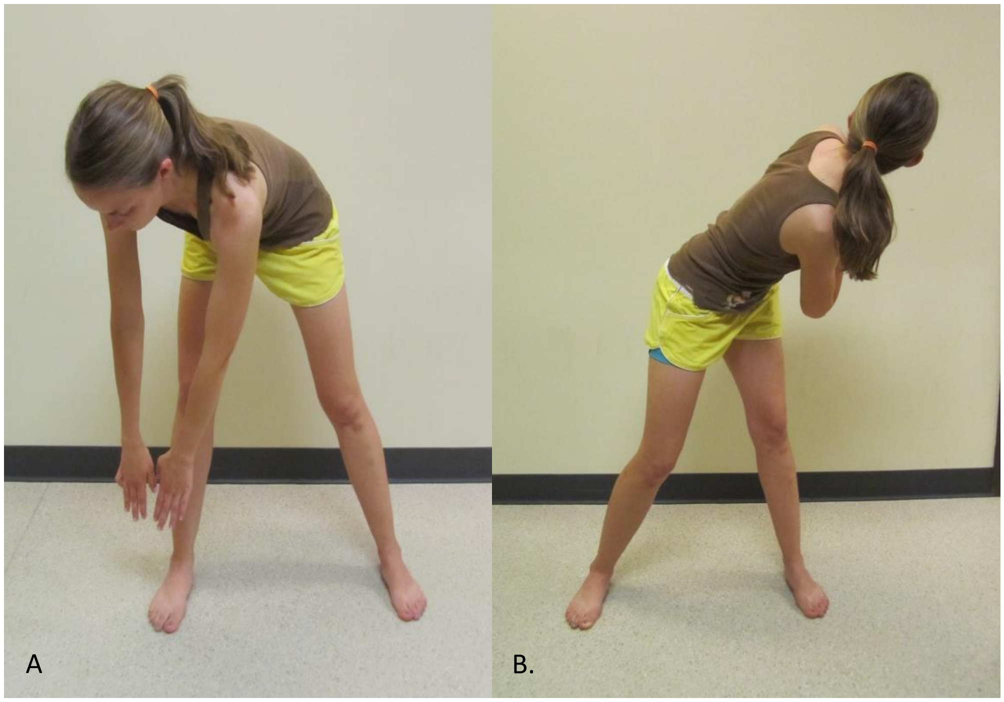


Figure 5.3. Active knee extension (AKE) assessment.

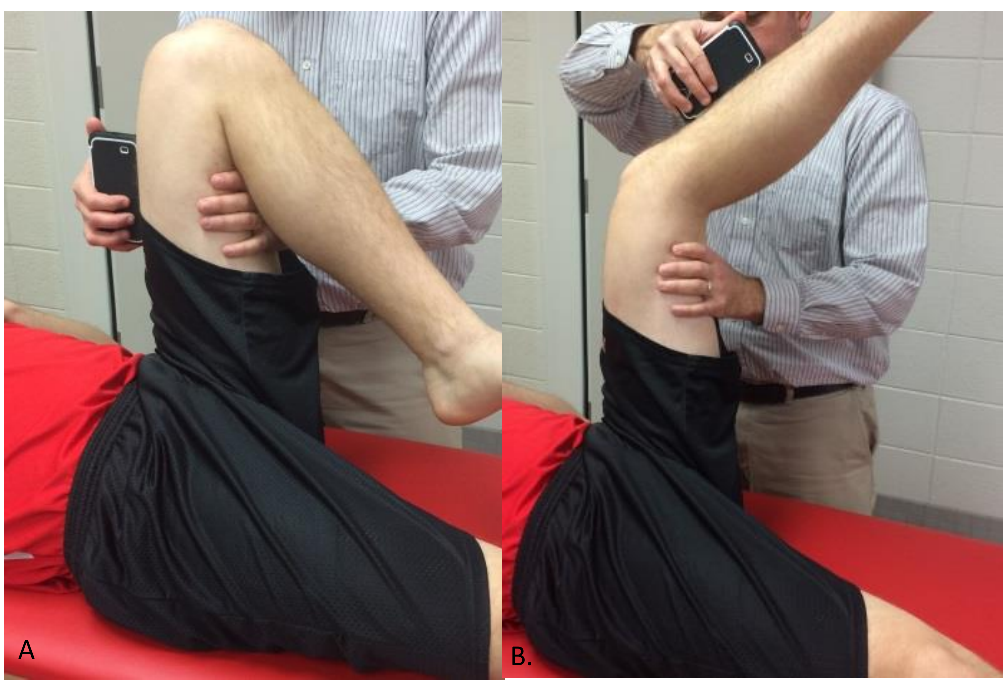


Figure 5.4. Passive straight leg raise (PSLR) assessment.

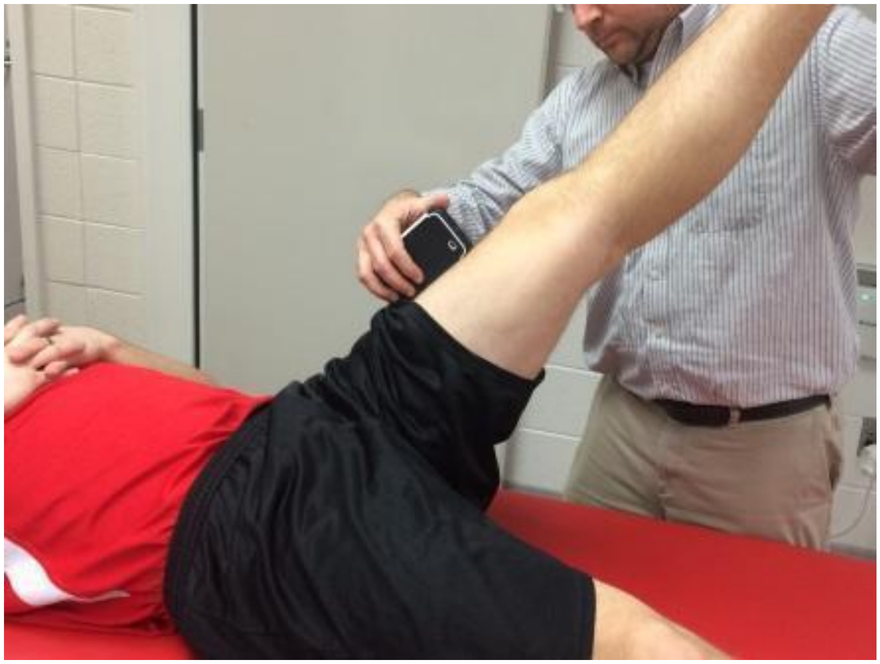
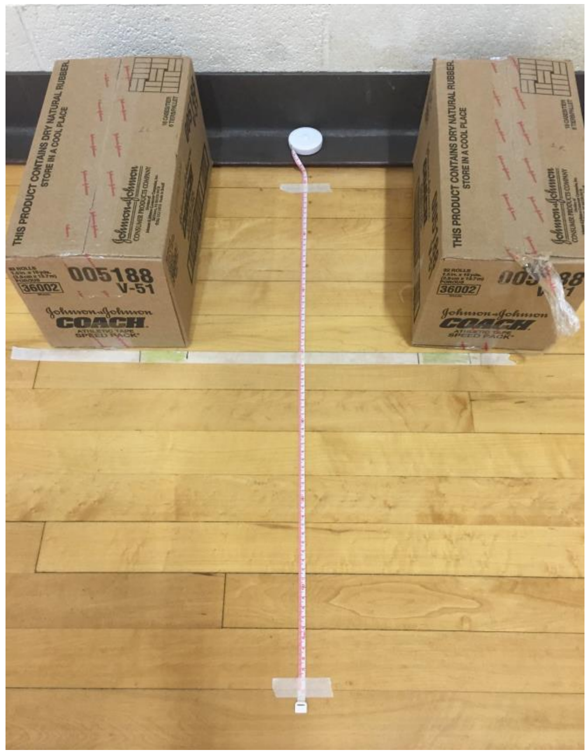


Figure 5.5. Finger to floor distance (FFD) assessment.

Figure 5.6. V-sit and reach (VSR) set-up.



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